Radio and Electronics

OUR COVER:

Television, pre-electronic scanning type. The picture produced by this antiquated-looking gear consisted of only 30 lines, so that only about 900 picture elements were able to be resolved as against something like 250,000 in a modern high-definition system.

Official Journal of
The N.Z. Electronics Institute (Inc.).
The N.Z. Radio and Television Manufacturers' Federation.
The N.Z. Radio Traders' Federation.

Managing and Technical Director:
W. D. FOSTER, B.Sc.

Subscriptions:
1s. 10d. per copy; 23s. 6d. per annum, posted.
Advertising Rates supplied on application.

CORRESPONDENCE
All correspondence and contributions should be addressed to:

The Editor,
"Radio and Electronics,"
P.O. Box 8022,
Wellington, N.Z.

OFFICES AND LABORATORY:
Radio and Electronics (N.Z.), Ltd.,
46 Mercer Street, Wellington.
Telephone, Wellington, 70-216.
Telegrams and Cables:
"Radel," Wellington.

SOLE ADVERTISING REPRESENTATIVES for THE UNITED KINGDOM:
Cowlishaw and Lawrence (Advertising), Ltd., 28 New Bridge Street, London, E.C.4.
Telephone City 5118.
Cables: Cowlawads Cent, London.

VOL. 8, No. 8 1st OCTOBER, 1953

Contents

	Page
Editorial	2
A New Method of Triggering Photographic Flash Tubes	4
Loudspeaker Enclosures (by V. M. Stagpoole)	9
Shoes and Ships—by special arrangement with the Walrus—Accent on Meters	12
Audiofacts No. 4—Low Frequency Response in Audio Amplifiers	15
Valve Curves and Cathode Biasing	18
The *Radio and Electronics* Abstract Service	23
Philips Experimenter No. 72—Circuit and Wiring Considerations When Using High-gain Valves at High Frequencies	24
Proper Electronic Wiring Techniques—by the Engineering Department, Aerovox Corporation	27
For the Serviceman—Philips Radioplayer Model 601	33
The "R. and E." Synch. Signal Generator, Part VIII	35
New Products	38
Wellington Radio Traders' Association	39
N.Z. Radio and Television Manufacturers' Federation	41
Proceedings of the N.Z. Electronics Institute Inc.	42
Trade Winds	43
Publications Received	46
Classified Advertisements	47
Television News (through courtesy of Dominion Radio and Electrical Corp.)	47

Sole New Zealand Distributors: Gordon & Gotch (N.Z.) Ltd., Wellington

PRINTED BY HARRY H. TOMBS, LTD., WINGFIELD STREET, WELLINGTON.

TV "OFF THE AIR" IN WELLINGTON

This title might well be taken to have a double meaning, and we would not complain if either is taken by the reader. Television is certainly not on the air, or even in it (as we have recently had cause to complain), in so far as the Government is concerned. It has taken a private firm and private enterprise to demonstrate the first actual transmissions of television signals by radio, ever to take place in the North Island. But for the Canterbury College School of Engineering, the demonstration put on by Messrs. Collier and Beale Ltd. would have been the first radio transmission of high-definition TV in the whole country. However, the achievement loses none of its significance on that account. There are several worthwhile features of the demonstration that has just taken place, not the least of them being the way in which it has proved the existence of considerable public interest in the subject—even if that interest did rather embarrass the organizers by its extent! Its most significant feature, however, is the conclusive way in which it has proved that a New Zealand firm can of its own initiative, and solely with its own resources, successfully apply the manifold and complex techniques of modern television, with little or no prior experience. There is no doubt, in our minds at least, that the firm concerned is only one of several which could have made such a pioneering step, but the fact remains that this one did. Its initiative and technical resource, coupled with a firm faith in the future of television in this country, have enabled it to perform a signal service to the radio industry as a whole. While the industry thrives on keen commercial competition, its members would be the last to deny Collier and Beale the credit that is their due for showing the public at large that the radio industry is fully capable not only of producing TV receivers fully up to overseas standards, but also of indulging in considerably higher flights of technical achievement.

In this latter statement there is a lesson for certain Government departments, for TV activity, successfully carried out, is on a considerably higher level of achievement than common-or-garden radio. It is not unlikely that, in the case of a further war (from which Heaven protect us), the New Zealand radio industry would be called upon for manufacturing efforts far overshadowing even their notable achievements of the last war. The equipment which would be needed would in all probability be as far in advance of present-day TV technique as it is ahead of radio sets, so that if the industry is to play its part in any emergency of this kind, it will need to have become familiar with things that are far ahead of its present activities. Television, we think, is an indispensable stepping-stone towards this essential goal. It will necessitate the employment of more men of the highest technical calibre than are in it today, and this will automatically enable more advanced defence work to be undertaken here, than that with which some people believe the industry could cope. Would it not be better if the surplus capacity of our larger radio factories were devoted to advanced electronic work instead of to the construction of electrical appliances, which can be turned out by firms with neither knowledge of nor interest in the electronic arts?

We have moved rather far afield from our title, but these are the thoughts quite logically conjured up by this TV demonstration. They emphasize the importance of our industry's keeping itself up to date. Mr. Collier and his associates have given us all much food for thought, and have done an important secondary industry a very great service since it seems to be generally agreed within that industry, that TV is something with which we should get on as quickly as possible. Unfortunately, the decision does not altogether rest with the firms concerned, but with a Government which does not appear to like making up its mind. The demonstration we have just witnessed will at least bring home to the public that there is no technical reason why we should not have television.

'R. & E.' TV Course for Christchurch and Repeat Course for Wellington

In view of the success of the recently completed "R. and E." television courses in Wellington and Palmerston North, and the general interest in this subject throughout New Zealand, we are considering, not only repeating the course in Wellington for the benefit of those who could not be accommodated this time, but also delivering the same course of lectures in other centres, should sufficient support be evident.

Christchurch and other South Island readers interested in such a project, therefore, are requested to complete the attached form and return it to this office as soon as possible, so that we might gauge the measure of likely support. Tentative plans have been made to hold the course in Christchurch in March, 1954, over a period of ten successive nights, excluding Sundays. Though this might appear too concentrated an effort, we mention that the stout-hearted students in Palmerston North assimilated the full course in four days, working five hours each day. In Christchurch, the same demonstration equipment will be used as in the previous two courses.

As requests for a repeat course in Wellington are mounting daily, we are considering giving this in February, 1954, on lines similar to those published on page 11 of the June, 1953, issue of *Radio and Electronics*. Those interested are therefore requested to complete the attached form and return it to this office as soon as possible.

Should the return of the signed forms evidence sufficient interest in these proposed courses in Christchurch and Wellington, arrangements will be finalized and full details published in *Radio and Electronics*.

Details concerning the general scope of the course were published on page 47 of the April, 1953, issue of *Radio and Electronics*, and copies of the syllabus outlining the contents of each lecture may be had on application to Radio and Electronics (N.Z.) Ltd., P. O. Box 8022, Wellington.

RADIO & ELECTRONICS (N.Z.), LTD.,
P.O. Box 8022,
WELLINGTON.

I am interested in and would be prepared to attend the proposed TV Course to be held in *Wellington/Christchurch during *February/March, 1954.

Name .....

Address .....

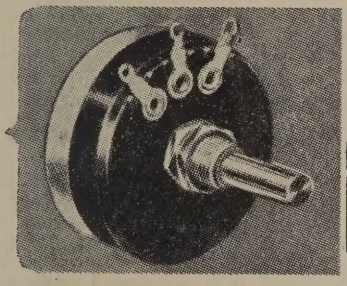
.....

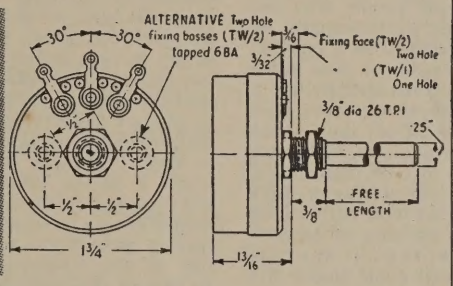
.....

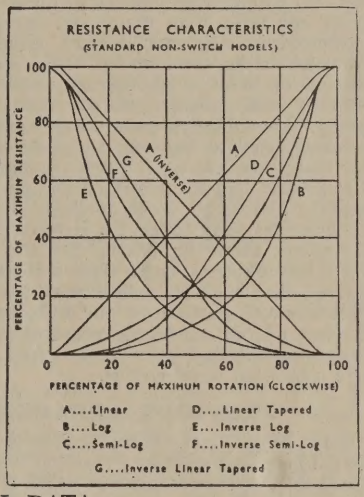
*Strike out city and month which do not apply.

RELIANCE POTENTIOMETERS

—BRITISH TO THE CORE







CONTINUOUSLY VARIABLE WIRE WOUND AND COMPOSITION TYPES

Quality is the keynote in Reliance design and manufacture. The resistance wire is of nickel-chrome or copper-nickel alloy. Terminal ends are specially metallized to obtain negligible resistance at end of travel of contact arm. Resistance element is impregnated with neutral elastic varnish. Two or three units ganged to common spindle are available in any combination within the standard resistance range.

MECHANICAL DATA:

Available in either one or two-hole fixing. One-hole fixing bush $\frac{3}{8}$ in. diam., $\frac{3}{8}$ in. long from mounting face. Less in two-hole fittings. Standard Spindles $\frac{1}{4}$ in. diam., 1 in. long (free length). Spindles slotted or with Flats available for different knob types. Resistance to overturning knob is 10 lb. — in.

ELECTRICAL DATA:

Wattage ratings for whole element uniformly loaded (linear winding, Curve A); considerably reduced when resistance element graded or used as rheostat. Resistance elements correct to + or — 5% stated value. Terminal resistance at end of wiper arm travel negligible. Resistance windings graded to R.C.M.F. standards (ilustrated graph). Specify grading letters when ordering. Tested to withstand 1000v. D.C. between spindle and cover, spindle and wiper arm.

NEW ZEALAND DISTRIBUTORS:

TURNBULL AND JONES LIMITED

Auckland Wellington Christchurch Dunedin Hamilton Palmerston North Invercargill

A New Method of Triggering Photographic Flash Tubes

The circuits used for operating electronic flash tubes for photography have always seemed to us to leave something to be desired. Accordingly, a new method of triggering the flash has been developed which does away with many of the disadvantages of the conventional method. Increased reliability is the main feature of the circuit.

INTRODUCTION

The subject of electronic flash units for photography is a very interesting one, not only to the photographer, but also to him who dabbles in things electronic. Judging from our talks with many and various people who are interested in electronic devices, either professionally or from an amateur standpoint, there seems to be a curious association between photography and radio, in that numbers of radio men seem to pursue photography as a hobby. Accordingly, quite large numbers of radio men are interested in building an electronic flash unit either for their own use or for that of someone else. Hitherto, this journal has not published any circuits for flash units, because almost all those available commercially or built by amateurs seem to use the same circuit with only minor variations. However, having had the question of designing a better-than-average flash unit put to us, it was considered that such an article would well come under the "Electronics" portion of our title, and might interest a number of our readers. Accordingly, a new method of triggering the flash was worked out, and forms the basis of a somewhat novel circuit.

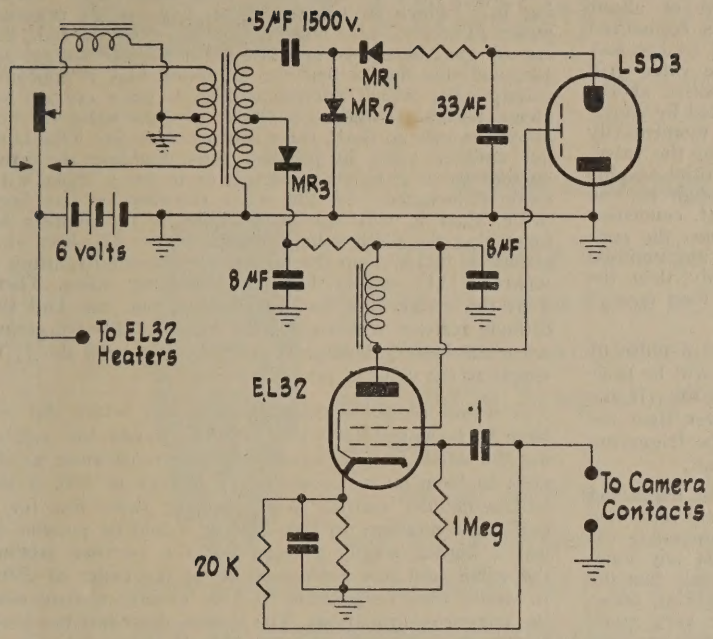
PREVIOUS ARRANGEMENTS

First of all, and before dealing with the circuit presented here, it would be as well if we described the flash tube itself, and the manner in which it works.

The flash tube is nothing more than an evacuated glass tube, filled with one of the rare gases at the correct pressure, and having an electrode sealed into the glass of the tube at each end. The tube is quite narrow, with a bore of about $\frac{1}{8}$ in. inside diameter, and is about a foot long. In order to make it more compact, the tube is shaped into a spiral of five turns, approximately $\frac{3}{4}$ in. diameter. The remainder of the tube is then brought down through the centre of the spiral so that the two ends are in close proximity. The portion which descends from the top of the spiral, through its centre, is widened out to a diameter of approximately $\frac{3}{8}$ in., and is surrounded by a close-fitting wire mesh. In order to operate the tube, a D.C. voltage of up to 2,700 volts is impressed across the electrodes sealed into the ends of the tube. This voltage, high as it is, does not cause the gas in the tube to conduct, and so unless we do something about it, the high voltage supply has no effect and we obtain no flash. This is where the wire mesh electrode, outside the tube, comes into play. To this, we must apply a momentary voltage, or pulse, of very high amplitude. Its duration does not matter, and when it occurs, it triggers the flash tube, which immediately conducts, producing its intense flash. Presumably, the triggering electrode, by producing a much more intense electric field in the vicinity of one of the main electrodes than is present due to the standing high voltage across the tube, causes some of the gas molecules to ionize; collisions between ions and un-ionized molecules cause more to become ionized, and so on, so that ionization becomes a chain reaction, similar to that which takes place in an atomic explosion. When, after a very small fraction of a second, sufficient ions have been formed, they are able to carry an electric current—which the un-ionized atoms are unable to do—and the gas becomes a conductor of electricity with a very low resistance, instead of an almost perfect insulator. This is the manner in which the gas breaks down, and the energy contained in a large condenser, charged to the 2,700 volts which is applied to the tube, is discharged in a very short space of time through the gas. In doing so, the energy becomes dissipated, partly in heat in the tube, but also in light energy given out through the transparent walls. This, of course, is the useful output of the flash tube. Its action is rather similar to that of a thyratron, except that the "grid", if such it may be called, is *outside* the tube, and also that the tube is made in such a way that a high voltage is needed to break it down. The higher the voltage, of course, the more energy is contained in the condenser, and the more light that is produced at each flash. The amount of energy passed through the tube depends also on the size of the condenser which is discharged through it, so that in designing a circuit, it is necessary to consider the maximum energy per flash which may be passed through the tube without damaging it. This is measured in joules, or watt-seconds (which is the same thing) and the usual flash tube, the LSD3, is rated at 100 joules per flash. The condensers normally used for the purpose are specially made for the job, and have a capacity of 33 μf. For a 100-joule flash, this means that the condenser must be charged to 2,500 volts, and so this is the voltage rating of the condenser. Of course, it is possible to use a lower voltage, and get a correspondingly less brilliant flash, and for many purses, 2,000 volts, giving a 61-joule flash, would be quite sufficient. For amateur purposes, for example, it would be preferable in some ways to put up with this, and thus increase the life of the condenser. However, most units run the tube at its full rating, since professional photographers usually want as much light as they can get.

With this brief excursion into the whys and wherefores of flash tubes, we can now examine the method used for triggering them. The primary triggering source, needless to say, must be a pair of contacts mounted inside the works of the camera, and operated by the shutter. The usual arrangement which prevents synchronization from having to be inconveniently accurate is to open the shutter for a time which is much longer than the duration of the flash, and arrange the contacts to trigger the flash about half-way through the time during which the shutter is open. When this is done, the degree of photographic exposure is regulated not by the duration of the shutter opening but by the setting of the lens aperture or "stop." Thus, the closing of the camera contacts must initiate the flash, and the question is, how are they to do this? As we said earlier, the tube is triggered by applying a short pulse of very high voltage to the triggering electrode, so that the triggering problem resolves itself into two parts. First, some means must be provided for making a high-voltage pulse, and secondly, means must be provided for initiating this pulse by the closing of the camera contacts.

The most popular scheme for triggering is to use a small induction coil, which is merely a very inefficient type of iron-cored transformer, with a very high voltage step-up ratio. The primary winding has a very low



impedance, and if a large *current* is passed through it for a very short time, the result at the secondary terminals is a large *voltage* pulse, for an equally short time. The current is usually obtained by charging up a condenser of, say, 1 μf., to about 150 volts, and allowing it to discharge rapidly through the primary of the induction coil when the camera contacts close. The triggering pulse required is about 3,000 but this is easily provided by a small induction coil. Some people who have built their own flash units have used spark coils designed for the ignition circuits of model petrol engines. These fill the bill admirably, but are almost impossible to obtain in this country. In addition, this simple triggering arrangement suffers from several disadvantages. In the first place, the discharge of the 1 μf. condenser causes a momentary but heavy current to flow through the camera contacts. Should these become dirty or pitted through sparking, there is every probability that sooner or later their resistance will become so high that the triggering condenser cannot discharge quickly enough to give a heavy enough surge of current through the induction coil primary to produce a voltage impulse of the required amplitude. What happens then is simply that when the user clicks his shutter, the lamp does not fire! This is annoying enough for an amateur, but for a professional photographer it may represent the loss of a good photo, which in his case can be very costly. Accordingly, where the utmost reliability is required, it seems advisable to develop a triggering device which passes as little current as possible through the camera contacts.

OTHER REQUIREMENTS

In considering the design of a complete unit, several things have to be taken into account. The primary source of voltage is usually required to be an accumulator, which must be as small and light as possible. This will be used to actuate a vibrator type of high-voltage supply for charging the 33 μf. condenser which is connected across the lamp. In the induction coil triggering method, the 1 μf. condenser is usually charged to the required voltage from a voltage divider placed across the main 2,500v. supply, so that no additional supplies are needed. There are several methods of geting the 2,500 volts from the high-voltage vibrator transformer. One is to use a transformer giving a peak voltage equal to the 2,500 volts needed, and to use a half-wave rectifier circuit with a miniature H.V. rectifier valve. This is usually an EY50, which has a low-consumption heater. The circuit in this case is so arranged that the rectifier heater and cathode are at the same potential as the battery (i.e., "earthed" to the metal case of the whole device. Unfortunately, this scheme is not as reliable as it might be, because it is quite easy for the EY50 to give out, in which case the unit will not work again until the tube has been replaced. It is a wire-in type, and so it is not safe for non-technical users to replace it themselves, and a faulty rectifier tube means a trip to a competent serviceman. A better arrangement is to use metal high-voltage rectifiers. These have almost unlimited life under even the difficult conditions imposed by the flash unit, and will ordinarily outlast the rest of the equipment.

A better scheme than using a transformer for the full voltage is to have it wound for half the needed voltage, and use a voltage-doubling rectifier circuit. This makes the transformer smaller and less expensive, but requires two rectifiers. These will not cost twice the price of a single rectifier for the full voltage, and so there is a net gain to the purchaser. This circuit is used in the arrangement of the theoretical circuit diagram given here. MR_1 and MR_3 are rated at well over 1,000 volts each, by the simple expedient of using a series arrangement of three units for each. These can be of the type rated at 360 volts r.m.s. sine-wave input, so that the maximum allowable input voltage for the circuit using three of them for MR_1 and a further three for MR_2 would be just over 1000v. r.m.s., or 1400v. peak. With a vibrator, however, the output waveform is square, so that the required secondary voltage will be 1250v. peak. This is the figure a maker of vibrator transformers would require if he were given an order for a suitable transformer. Actually, it woud be better to reduce the transformer to 1,000v. or 1,100v., to allow for extra voltage being generated when the battery voltage is 6.6, immediately after charging. The one used in our own experimental work was nominally 1,000v., and gave a measured output from the rectifier of 2,500v. with a fresh battery, using the voltage-doubler circuit shown. The 0.5 μf. condenser does not have to stand more than the peak transformer voltage, and so 1,500v. rating is quite adequate.

THE NEW TRIGGERING METHOD

The lower part of the circuit shows how triggering is effected in the new system which has been developed. From a tap on the main transformer, placed so as to deliver a peak voltage of 150, the low-voltage rectifier MR_3 is fed. The rectified voltage is smoothed and applied to the valve circuit as its H.T. supply. The valve has in its plate circuit an iron-cored choke rated to have an inductance of approximately

200H. at a current of 100 ma. The valve is cathode-biased so that it passes a plate current of about this value. The 0.1 μf. grid condenser is connected to the cathode through a 20k. resistor, and so becomes charged up with the plate connected to the valve grid at earth potential, and the other plate positive at the potential of the cathode. Triggering is effected by short-circuiting the condenser to earth, thereby momentarily placing a small negative pulse on the grid of the valve. Let us suppose that the cathode is at a potential of plus 16 volts, owing to the current flowing through it. The grid bias is therefore —16v. Now the 0.1 μf. condenser is charged to the same voltage, so that when the contacts are closed, a negative pulse of 16v. is superimposed on the steady negative grid bias. Momentarily, then, the bias is increased to —32v., which is more than enough to cut the valve off.

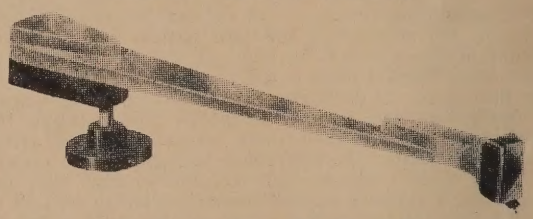
The action of cutting off the valve causes a pulse of voltage to appear across the plate choke. It will be positive, and will have an amplitude of over 3,000v. if the choke has an inductance equal to or greater than the 200H. mentioned. This pulse is applied to the triggering electrode of the flash tube, and triggers it off.

The advantage of this system is that the triggering pulse is produced in a circuit which is entirely separated from the camera contacts. It is virtually impossible for these to receive the triggering pulse should any component break down, so that it is equally unlikely that the operator can receive a kick from the triggering pulse. Another advantage is to be found in the very small voltage and current applied to the camera contacts, and as a result of this, damage to them either by failure of any component, or in normal use, is virtually impossible. It also makes for much more reliable triggering of the flash tube, because even if the contacts become dirty with age, the small current that is passed through them by the 0.1 μf. condenser will not be affected to any extent by contact resistance. The big disadvantage of induction coil triggering is thus removed. It is true that more components are used, including a valve whose heater must be run from the battery, but the small additional drain will hardly affect the battery life, because the very heavy drain which occurs while the main condenser is discharging accounts for most of the ampere-hour capacity of the battery in any case.

It will be noted that some of the circuit values have not been inserted in the circuit. This has been done on purpose to indicate that these are left in great measure to the individual builder. It would be useless to specify them exactly unless the characteristics of the triggering choke in the EL32 plate circuit were accurately known. As it is, this component will have to be specially made to order, since it is not a standard one, with the result that wide differences in the actual inductance will be encountered. The same thing goes for the filter resistor for the low-voltage supply. This may be omitted altogether, if desired, but it does provide a little extra smoothing for the supply. It is not at all essential, however, but a total capacity of at least 16 μf. from the rectifier to earth should be used, in order to give better regulation to the supply. The cathode should be by-passed by a 25 or 50 μf. condenser, because unless it is, negative feedback will reduce the effect of the negative pulse applied to the grid and may prevent triggering. The cathode resistor can be adjusted to a value that gives the most reliable triggering when the battery is almost down to 1.8v. per cell. or a total of 5.4v. With only about 150v. D.C. on the plate and screen of the EL32, triggering may be a bit marginal at low battery voltages unless the current is run up to 15 or 20 ma. However, with this system care must be taken not to use too high a valve current, because this means a low standing bias, which in turn means a low-voltage negative pulse. The D.C. bias must not be less than one-half the cut-off grid bias for the valve with a plate voltage of 125, and this means that the minimum bias is approximately 12v., which corresponds to a plate current of about 14 ma. If these conditions for the valve do not allow the tube to flash, there are two remedies. One is to put another valve in parallel, thus doubling the plate current for a given bias voltage, or to use a choke with more inductance. If the main transformer has been made, then it will not be possible to fix matters by increasing the plate voltage on the valve. The best procedure is to build up the circuit experimentally, using a separate D.C. supply for the triggering valve. Then, with the choke that has to be used, one can find the cathode resistor which gives the most reliable triggering when the battery voltage is down to 5.4v., and the H.T. supply to the valve is, say, 125v.

It would be quite practical, in a unit which did not have to be portable, to use the A.C. mains for supplying the whole unit, in which case the transformer would need to have an r.m.s. secondary voltage of 900, if the voltage-doubler rectifier were used, or twice this for a half-wave rectifier. In this case, it would be possible to use a higher supply voltage for the rectifier feeding the valve, and this could well be of the order of 250v. It would then be possible to have greater control over the triggering conditions. The system described has been used with every success on the beach, in our laboratory, and at a later date it is hoped to describe a completely built-up portable flash unit using this novel and very reliable triggering system.

NOW IN STOCK



ACOS G.P.20

FOR THE DISCRIMINATING LISTENER

A new departure in pick-up design, the ACOS G.P. 20 incorporates all the refinements and improvements which ACOS has been able to devise. It can be fitted without gadgets, causes a minimum of record wear, is tremendously robust, AND, MOST IMPORTANT OF ALL, IT GETS THE BEST POSSIBLE REPRODUCTION FROM COMMERCIAL RECORDINGS.

Ample stocks of replacement heads and pins, both standard and long-playing.

SWAN ELECTRIC CO. LTD.

Auckland Wellington Christchurch

Osram VALVES

Pointers for Designers

AND CONSTRUCTORS

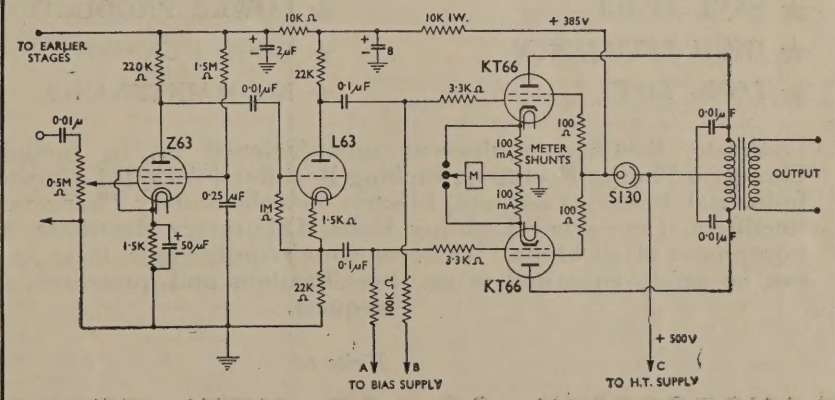
KT66 — BEAM TETRODE

The OSRAM KT66 is a tetrode having an anode dissipation of 25W. It may be used as an audio amplifier or an oscillator and radio frequency amplifier, up to 30 Mc/s.

As an audio amplifier up to 50W. may be obtained from two valves, tetrode connected. As a push-pull triode it has no equal for use in high quality equipment when an output of 14/15 watts is required.

The KT66 is very robust, both electrically and mechanically, hence it is suitable for many industrial applications.

Typical circuit of 50W class ABI amplifier



Write for data on the KT66 to: Osram Valve & Electronics Dept.

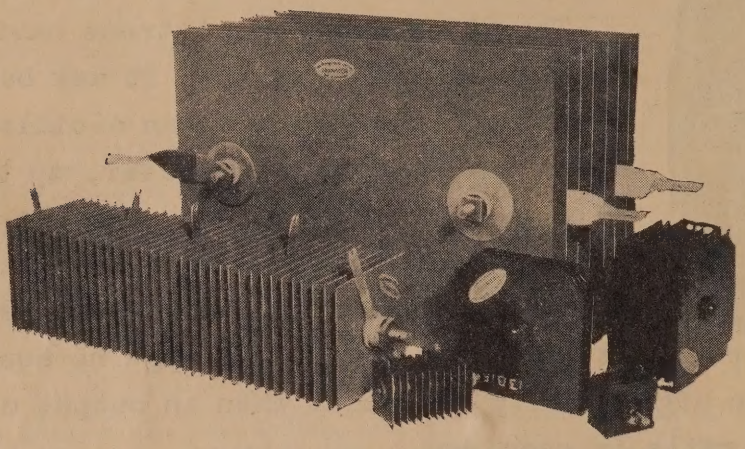
BRITISH GENERAL ELECTRIC CO., LTD.

WELLINGTON AUCKLAND CHRISTCHURCH DUNEDIN

For EFFICIENCY and ECONOMY

the answer is

SELENIUM RECTIFIERS



Selenium Rectifiers manufactured by the Transformer Company of New Zealand Ltd. incorporate up-to-the-minute technique in design and construction to meet the most exacting requirements of modern radio, electronic, and telecommunication engineering. Their advantages are manifold.

- ★ SAVE WEIGHT
- ★ SAVE COST
- ★ SAVE SPACE
- ★ HIGH EFFICIENCY
- ★ LONG LIFE
- ★ MAXIMUM STABILITY
- ★ MECHANICAL STRENGTH
- ★ LOWER PRODUCTION COSTS
- ★ COOL RUNNING
- ★ NO MAINTENANCE

Complete Rectifier equipment manufactured by us includes Trickle Chargers, Plating Rectifiers, Etching Rectifiers, A.C./D.C. Conversion Sets, Industrial Battery Chargers, Electric Vehicle Battery Chargers, Anodizing Rectifiers, Emergency Lighting Units, Laboratory Rectifiers, and Special Equipment of all kinds. Whatever your requirements, large or small, they can be safely entrusted to us. Specifications and quotations supplied on request.

Write to

TRANSFORMER CO. OF NEW ZEALAND LTD.

Telephone 61-498 **78 NELSON STREET, PETONE** **P.O. Box 175, Lower Hutt**

Loudspeaker Enclosures

By V. M. STAGPOOLE

This article might almost be entitled "There are More Ways of Baffling a Speaker than Putting it in a Telephone Box," but that, unfortunately, is just about what is required if one wants to use the reflexed enclosure with a modern low resonance loudspeaker. The answer is fairly obvious. Let's not bother with a reflexed enclosure, there are other methods available which are capable of providing better results. It is well known that we rapidly become accustomed to the sound reproduced by our own radio system, be it ever so humble and for this reason we should take every opportunity to listen to dance bands, orchestras, etc., in the flesh, so that we know what they really sound like. It will be found that there is more bass in live performances than we get from our speakers, and the reason for that is not far to seek. Almost every loudspeaker system exhibits a falling response below 100-200 cycles per second. I came across the response curve of a highly touted 15 in. speaker in a specially designed reflex box the other day and it showed a response down 10 db. at 50 cycles, below that the manufacturer had not bothered to run a curve. Now, is it possible to get real bass from a system like that? It should be of interest to examine some of the faults in the average bass reflex system and the efforts which have been made to overcome them.

THE BASS REFLEX CABINET

The theory behind the operation of the reflex system is well known. The box is "tuned" to the free air resonance of the loudspeaker to be used with it and designed so that when the speaker is installed it is loaded by the stiffness of the enclosed air at that frequency. In theory we should have a flat response down to this frequency, and a rapidly falling response below it. We get the fall all right but it usually commences much higher than it should. This falling response is probably due to the fact that the enclosure is not a complete absorber of frequencies above the resonance to which it is tuned, and the speaker output is being short-circuited by the part radiation at these frequencies.

Below the resonance of the system, usually in the 50-70 cycle range, the speaker is no longer mass controlled and simply freewheels. This causes the production of harmonics of the applied note, the consequent distortion rendering this part of the audio spectrum unusable unless one likes to hear these low notes reproduced an octave higher than they are played.

Apart from these more or less fundamental faults, there are practical difficulties in bass reflex design. As well as the required volume resonance we are plagued by a number of resonances associated with the other dimensions of the box. The major one of these is due to the height, which usually appears in the 80-90 c.p.s. region. This is often so severe that it produces the major peak in response, and is the cause of the "tubbiness" sometimes found in these systems.

All these faults would be of a secondary importance if we could get real bass out of the reflexed enclosure, and by real bass I mean output in the 25-30 cycle region, but since we cannot we must find a new method of approach, preferably something that we can bring into the house without having to move out half the furniture.

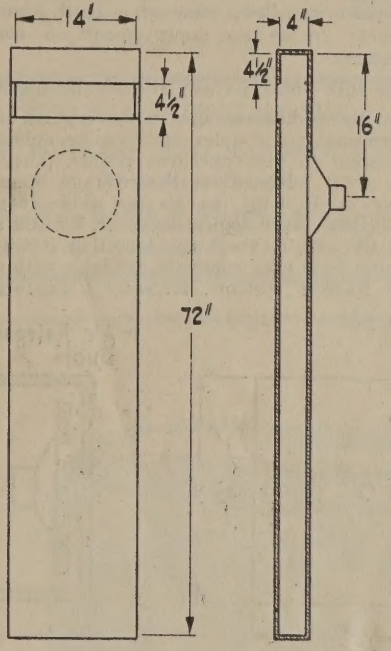


Fig. 1
The "Air Coupler"
(All Dimensions Internal)

A number of approaches to this problem have been made in recent years and two of these are of interest because of the different basic approach to each case.

THE AIR COUPLER

The first attempt at producing real "lows" in a domestic system was made by Flewelling in the United States. His approach boiled down to this, "Since we are going to get a major resonance due to the height or length of our encloseure, and very little below it, let us shift this resonance down an octave by making our enclosure six feet long instead of three." By this means, and by playing the speaker into the enclosure instead of from it, we arrive at the air coupler. It must be admitted that Flewelling did not stop at this, he also introduced considerable bass boost to help maintain good response. It will be seen from the diagram of the coupler (Fig. 1) that the major dimension of the coupler is much greater than the others and that consequently only this resonance will be of great importance. Notice also that the speaker is playing on to a flat surface and this, with the loading of the pipe resonance itself will reduce the major speaker resonance to quite a low figure.

The overall effect is to adequately load the speaker and produce a clean, usable output down to the 30-cycle region in a well designed unit.

Unfortunately the coupler suffers from a number of disadvantages:

(1) It cannot handle frequencies above about 400 cycles due to the generation of harmonics, so it requires a medium and high frequency speaker externally as well as an expensive cross-over network.

(2) It appears to be quite critical as to the type of speaker installed; some give good results, others appear to be no improvement on conventional systems.

(3) Its bulk limits its use in domestic installations.

Despite these disadvantages a number of adaptations of the original air coupler and similar systems are in use and seem to give excellent results. They are certainly a great advance on the average domestic bass reflex system. Perhaps the greatest achievement of the air coupler was psychological however, because it brought home to the audio expert the fact that it was possible to get better bass than currently available with more conventional speaker systems. Recently a number of new

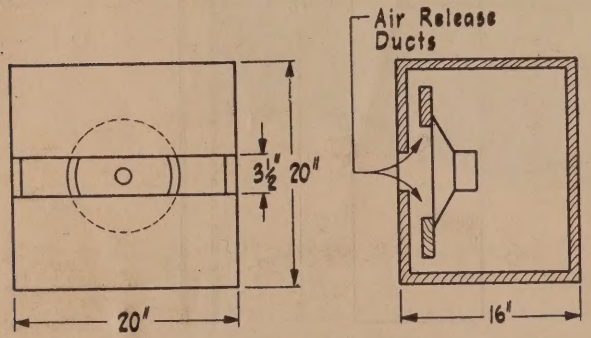


Fig. 2
R-J Enclosure
(Dimensions External)

speaker enclosures have appeared but, although some surprising results are claimed, no constructional details have been released in many cases. Such a case is the Karlson exponential slot enclosure whose response is claimed to be flat within 1½ db. between 100 and 25 cycles, and produces adequate cone loading down to 10 c.p.s. The best known system of recent origin is the R. J. Enclosure which is gaining great popularity.

THE R. J. ENCLOSURE

The approach in this case has been two-fold:

(1) The enclosure has been made of almost cubic dimensions to ensure that the volume resonance is the only major resonance to be dealt with (a diametrically opposed approach to that used in the air coupler).

(2) The enclosed air volume has a small release space ensuring maximum loading on the cone and consequently a greatly reduced resonance.

In Fig. 2 we have the plan of the enclosure and it can be seen how this end is achieved. The air release duct is indicated by the arrows in the figure. This duct acts as an acoustic resistance and controls the "Q" of the enclosure and the loading on the cone.

The dimensions of the enclosure give a resonance of 84 c.p.s. but this peak is controlled by the acoustic resistance of the slot expressed by the equation

$$Ra = \frac{kl}{t3w}$$

where k = a constant
l = length of duct passage
w = width of duct
t = thickness of spacing.

This thickness "t" is the spacing between the speaker board and the front of the box. Since the resistance is inversely proportional to the cube of this thickness it will be seen that halving the distance between the front and speaker board we increase the acoustic resistance eight times. Since we desire to control the "Q" and therefore the response of the box, the best method will

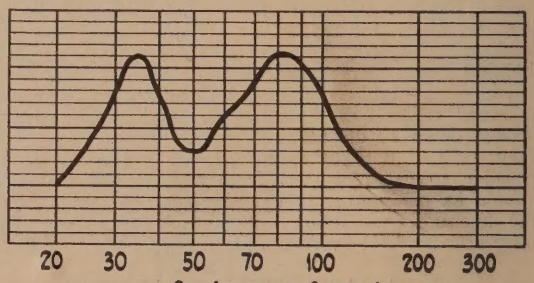


Fig. 3
Impedance Curve, R-J Enclosure, 12" Speaker
Free Air Resonance 45 cps.

be by adjusting the spacing rather than by any other means, such as increasing the duct length.

The construction of the enclosure is simplicity itself. The dimensions given are external, and for ¾ in. timber, and corresponding adjustments will need to be made if thicker wood is used.

THE FRONTAL OPENING

To adequately describe this rather odd shape is best done in the words of the original article in *Audio Engineering*.

"If the enclosure is to be used as a woofer exclusively a rectangular slot—as shown in Fig. 2—would be perfectly satisfactory, and adequate performance would be obtained over the frequency range from the lowest transmitted frequency up to 400 to 500 c.p.s. However, if the enclosure is to be used for a wide-range speaker, without the addition of any other speaker or horn for the high range, then the frontal opening must be modified. While the shape of the opening must be determined specifically for each individual cabinet type, it may be described roughly as resembling a "skinny lemon." It may be approximated by laying out a diamond-shaped opening with its major axis about 25 deg. from the vertical—at an azimuth of 025, for the nautical-minded—and with its minor axis at an angle of approximately 15 deg. from the horizontal, or at an azimuth of 295. The minor axis should be one-half the length of the major axis, and the total area should be calculated 64 sq. in. Then, after the diamond-shape is laid out, round off the obtuse corners, and extend the acute corners so that the "skinny

lemon" shape is attained. From this description, it is obvious that it would be difficult to prescribe the actual opening, but bear in mind that the low-frequency performance is a function of the enclosure volume and the area of the frontal board, and the high-frequency performance is a function of the shape of the frontal opening.

ADJUSTMENT OF SPEAKER BOARD SPACING

The spacing between the frontal board and the speaker board is adjusted so that no apparent peak is heard between 50 and 100 cycles/sec. It will be found that the spacing is between $\frac{1}{2}$ in. to 1 in.—generally about $\frac{3}{4}$ in. It will be seen from the impedance curve (Fig. 3) that the box exhibits two resonances, the 84-cycle one due to box resonance and the 35 cycles due to speaker resonance. This latter peak is usually much below the speaker free air resonance and is due to the loading. It is desirable to use a speaker with as low a cone resonance as possible, preferably below 60 cycles.

LISTENING WITH THE R.J.

One must not expect to hear big bass immediately the R.J. is connected. Unfortunately, not all records available have real bass on them. In fact it is doubtful if one

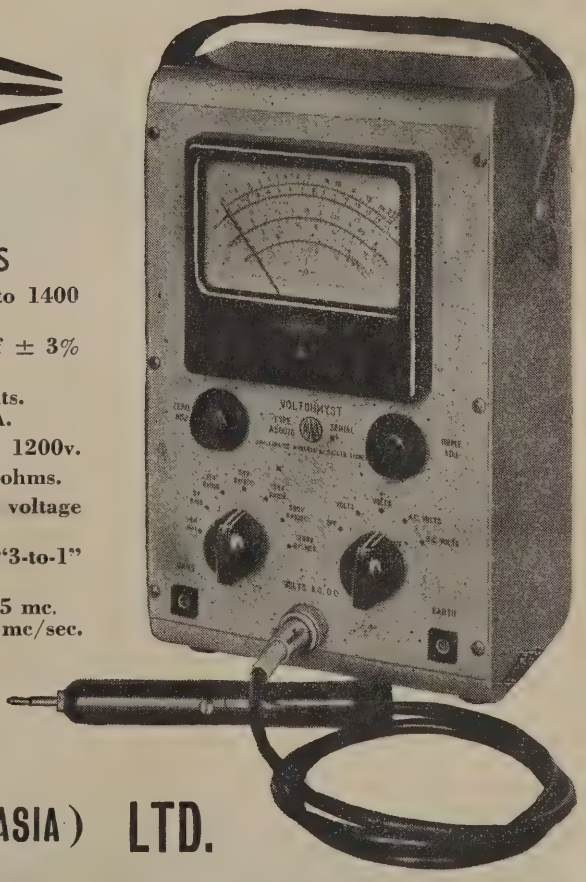
(Continued on Page 39.)

HOME CONSTRUCTORS
FOR VALVES AND COMPONENTS
Write or call on
Cambridge Radio & Electrical Supplies
Box 6306 or 38 Cambridge Ter., Wellington

ACCURATE
DEPENDABLE
VERSATILE
AWA VOLTOHMYST

SOME OUTSTANDING ADVANTAGES

(1) Directly measures complex waves from 0.2 volts to 1400 volts, peak-to-peak.
(2) Has an overall accuracy for D.C. measurements of ± 3% of full scale.
(3) Measures D.C. voltage from 0.02 volts to 1500 volts. Measures D.C. current from 0.02 mA. to 1500 mA.
(4) Measures r.m.s. of sine-wave voltages from 0.1 to 1200v.
(5) Measures resistance from 0.2 ohms to 1,000 megohms.
(6) Has 7 non-skip ranges for resistance, current, and voltage measurements.
(7) All full-scale voltage points increase in a uniform "3-to-1" ratio.
(8) Frequency response flat from 30 cps. to approx. 2.5 mc. Response with Xtal probe may be extended to 250 mc/sec.
(9) Negative feedback circuit provides over-all stability.
(10) Fully-enclosed metal case shields sensitive electronic bridge from R.F. fields.



AMALGAMATED WIRELESS (ASIA) LTD.

WELLINGTON: COMMERCIAL BANK BUILDING, LAMBTON QUAY —— P.O. BOX 830
AUCKLAND: VULCAN BUILDINGS, VULCAN LANE —— P.O. BOX 1363

SHOES and SHIPS

"The time has come," the Walrus said
"To talk of many things. . . . "

By Special Arrangement with the Walrus

Accent on Meters

Several times in recent weeks I have been asked to express an opinion on which meter I would recommend for general service work in the usual radio workshop. Now there was a time when the enthusiasm of youth thought in terms of thousands of ohms per volt—the more the merrier and supposedly the better the meter. However, the passage of time has wreaked havoc with those ideas and the Walrus is now more than content with a meter of 500 ohms per volt. Admittedly this is a splendid instrument by a very well-known English manufacturer, but it is the only one in the workshop that can be considered reliable and that is the secret of its effectiveness. Sensitive meters are costly to build, delicate to use, and subject to change over a period of years, on top of which the vast majority of readings the average serviceman needs to take do not require an extremely sensitive meter. This remark will probably provoke an outcry of "What about A.V.C. readings?" and the answer is "Well what about 'em?" The number of times it is necessary to take A.V.C. voltage measurements is of no real consequence when compared with the frequency with which other measurements are taken. Anyway even the most sensitive meters load the A.V.C. system too much and it is better to isolate condensers and resistors associated with that circuit and subject them to individual and more searching tests.

Most radiomen will be familiar with the construction of meters and know how they work, but for the doubtful Fig. 1 shows the usual arrangement. Now to increase sensitivity the magnet must be made of special magnet alloys and have a high degree of magnetism. The coil must have many turns of very fine wire and be delicately balanced and the hair springs themselves must be very fine and accurately calibrated for tension. The counterbalancing of the pointer becomes more difficult due to the very lightness of the moving parts and good counterbalancing is necessary on a meter if it is to read the same standing vertically or lying down horizontally. The pointer itself must not have much mass since it is important to keep the whole moving structure very light. Having got all these conditions satisfied you probably have a very good meter and this is the instrument you are going to turn loose in the workshop to get thumped about from pillar to post! It will probably finish up like two or three the Walrus knows of which are lying around the workshop—very sensitive meters and hopelessly inaccurate. Of course, they were good meters once—but they just won't stay that way! Small changes in the tension of the hair-springs and ageing of the magnet (one of the major bogys) brings about big changes in the readings which would have probably little effect on a less sensitive meter.

The Walrus has also had many vacuum tube voltmeter enthusiasts try to convert him but while acknowledging their usefulness in certain directions, the findings are still the same. Upon the workshop wall hangs a very splendid vacuum tube voltmeter gathering dust week by week. It does all it's supposed

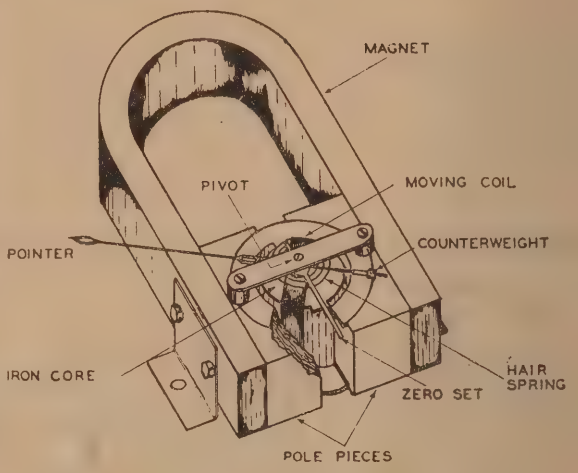


FIG. 1

to do, but it is messy to use—the zero has to be set up and it needs leaving for at least a quarter of an hour for it to stabilize and stop creeping (enthusiasts will argue for hours on this score). Generally if you want to make a measurement you want it in a hurry and can't wait that length of time for it. Some people I know switch their's on in the morning, first thing, and ostensibly its right then for the rest of the day but my 500 ohm per volt job is right if I should come in at midnight and nothing is running or wearing out when I'm not using it. Also I can take it out to a car quite readily to measure battery voltages and generator charging with absolutely no bother.

Frequently the Walrus finds it necessary to use a meter on a transmitter and it is here, particularly, that the V.T.V.M. gives me readings I do not like to believe—for instance, just sitting on the bench near the transmitter without any test prods connected is sufficient to make it read. Rather confusing!

However, for those diehards who won't give up, here's two crumbs—the sensitive milliammeter does make a useful high reading ohmmeter and the V.T.V.M. does likewise and (here it comes) has no real rival when it comes to measuring A.V.C. voltages!

BINDERS FOR "R. & E."

These are available to hold 12 issues—price 5s. 6d.

This book tells you how to

Have Radio in Every Room

Distributed throughout the Dominion
by

SWAN ELECTRIC CO. LTD.

AUCKLAND
WELLINGTON
CHRISTCHURCH

No. 10

LABORATORY NOTES

from

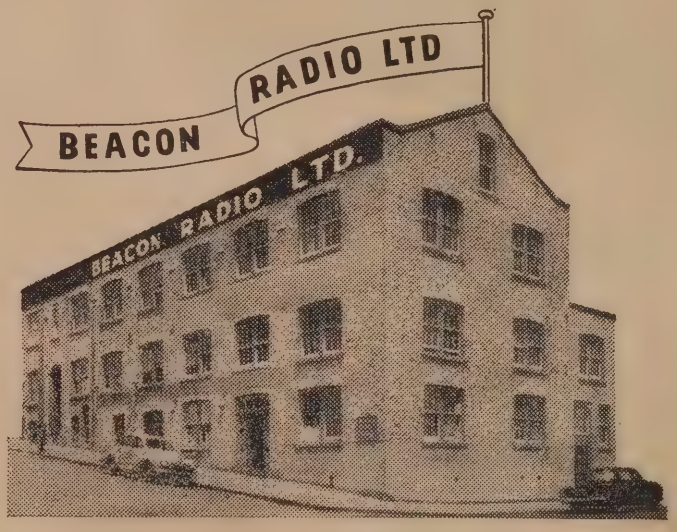
BEACON RADIO LIMITED

FILTER CHOKES FOR POWER SUPPLIES

Sometimes it is not realized that the inductance of a filter choke, or any other iron-cored choke, is influenced by the conditions of current, voltage, and frequency under which the choke works. Reputable manufacturers of filter chokes usually rate the choke inductance as that which will be presented under working conditions.

It is well known that the inductance of a filter choke can be greatly influenced by the passage of D.C. through it. An air gap is often provided for minimizing the saturation effect of the D.C. When a choke is designed with the aid of the appropriate Hanna's curves it is possible to predict the correct gap and number of turns for a given core size. The designer, however, must take into account other factors such as insulation requirements and the permissible winding resistance. Thus choke design becomes somewhat of an art.

The user of BEACON chokes may be sure that the ratings quoted apply to normal working conditions. BEACON chokes are designed to give efficient service with an economical use of materials.



Manufacturers of all Types of

TRANSFORMERS AND FLUORESCENT LAMP BALLASTS

BEACON RADIO LIMITED

Corner Brown and Fitzroy Streets, Ponsonby, Auckland. P.O. Box 2757. Telephones 14-704, 26-390

Audiofacts No. 4

Low Frequency Response in Audio Amplifiers

One of the most important features of any audio amplifier is its frequency response, and this may be specified quite separately for the low- and high-frequency ends of the scale, since in general, those features of a circuit which cause the low-frequency response to fall off, have no effect on the high-frequency response, and vice-versa. This is a very fortunate fact indeed, because if it were not so, the design of amplifiers would be a very much more difficult problem than it is.

It is not generally realized, moreover, that in amplifiers employing a large amount of feedback, it is essential for the range of flat frequency response to be much wider than merely the normal range of audio frequencies that are heard as such. For example, consider the behaviour of a feedback amplifier such as the Williamson, or the one whose circuit was published in last month's issue of *Radio and Electronics*. At some very low frequency, determined by the component values in the circuit, the feedback ceases to be negative, and actually becomes positive. This is due to the fact that the loss of amplification at extremely low frequencies is accompanied, whether we like it or not, by phase shift. If the amplifier has a great enough number of stages, this phase shift can amount to a full 180°, and this is equivalent to saying that the feedback which at middle frequencies is negative, is no longer negative at all, but is now positive, and constitutes regeneration. This regeneration is what invariably results in low-frequency oscillation, or motor-boating, when more than a certain critical amount of feedback is applied to the amplifier. It also limits the amount of feedback that can be safely applied, if valve changes, and natural alterations in the values of components, are not to cause the amplifier to become unstable.

At the high-frequency end of the scale, the situation is very similar, the only difference being that the phase shift accompanying the dropping off in the amplifier gain is in the opposite direction. The result is the same, however, if the total phase shift is 180°, and the gain is greater than unity, for in this case, too, oscillation will occur.

For the reasons just outlined, we are interested in the response of our amplifiers at frequencies far removed from the range of audible tones. In laboratories, and other places where there is a goodly amount of expensive equipment, It is a simple matter to run all the tests that might be nedeed on a new design of amplifier. There will be oscillators producing excellent sine-waves down as low as 0.1 c/sec., and right into the radio frequency range. With these, and suitable indicators, such as vacuum-tube voltmeters or oscilloscopes, it is possible to plot the response of the amplifiers down to the lowest frequencies, but how many of us who build or design our own amplifiers are able to do this? Yet it would undoubtedly allow us to gain a better understanding of the performance of our equipment, and thus result in our designing better amplifiers, with less guess work. Is there, then, any method whereby some, at least, of this knowledge may be gained without the use of laboratory equipment?

SQUARE-WAVE TESTING

As the heading of this article suggests, we do not intend to deal at present with high-frequency response, so that the answer is definitely "Yes," to the question at the end of the last paragraph. At least if we disregard the oscilloscope as a piece of purely laboratory gear. Those who possess these instruments can find yet another use for them by using square-wave testing for finding the low-frequency response of amplifiers. The method to be described enables us to find the frequency at which the response of an amplifier is 3 db. below the mid-band response, simply by applying a square-wave of known frequency to the amplifier, and after measuring two lengths on a simple 'scope pattern, working out a very simple sum. It works this way.

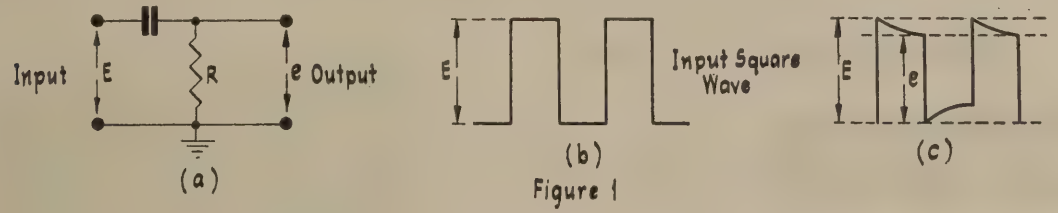


Figure 1

If a square-wave is applied to a CR circuit such as the one illustrated in Fig. 1, and we observe its shape at the output of the network, we will find that unless the time-constant of the circuit is very much larger than the time duration of one half-cycle of the square-wave, the latter will be distorted into the shape shown in Fig. 1 (b). The top and bottom of the wave, instead of remaining perfectly flat, will droop, and the shorter the time-constant of the circuit, the greater will be the droop. We know also, of course, that this effect is simply due to the fact that the CR circuit causes a drooping-off in the response at low frequencies, and that if the CR product, or time-constant, is made sufficiently large, the effect will hardly be noticeable. What is not so well known, however, is that there exists a simple relationship between the droop of the square-wave response and the response of the same circuit to a sine-wave. For example, if we measure the droop we are able to work out very quickly the frequency at which the sine-wave response is 3 db. down. Some knowledgeable readers will probably remark at this point, that it is an easy matter to calculate this frequency, given only the values of C and R, without recourse to experiment at

all. This is quite true, but where the measuring method scores, is in the fact that it can also be applied to multi-stage amplifiers, in which there are several CR coupling circuits, whereas to find the 3 db. point of a multi-stage amplifier by calculation is a long and tedious job which is hardly worth the effort involved. Indeed, the answer can be found by the square-wave testing method in five minutes, as against a more likely five hours for calculation from circuit values. All one needs apart from the amplifier itself and an oscilloscope of the simplest kind, is a source of square-wave of known frequency. In some cases it might be helpful if the frequency of the square-wave generator were variable, but this is by no means a necessity. In either case, the droop of the square-wave on the oscilloscope pattern is measured as:

$$\text{Droop Factor} = \frac{E}{E-e} = \frac{E}{x}$$

Then, we have the formula which says that

$$f_o = \frac{f_1 . x}{\pi . E}$$

in which

f_o is the frequency for 3 db. drop in sine-wave response,

f_1 is the frequency of the square-wave used for the test, and

π is 3.14.

E and x are the dimensions shown on Fig. 1 (c).

For example, suppose that we are using a 50-cycle square-wave, and that the droop factor $E/e = 10$. This would mean that

$$f_o = \frac{50}{3.14 \times 10} = 1.59 \text{ c/sec.}$$

Expressing this differently, we can say that an amplifier whose response is down db. at 1.59 c/sec.,

ANNOUNCING THE NEW

GRUNDIG "Reporter"

THE FINEST TAPE RECORDER IN THE WORLD . . .

The "Reporter" will record with the utmost fidelity any sound, voice, or music and play them back to you immediately . . . you can use the same tape again and again or keep your recordings for a lifetime.

A TELEPHONE ADAPTION: foot or hand-operated REMOTE-CONTROL SWITCH and EARPHONE CONNECTIONS are available as special attachments.

SPECIFICATIONS: Push-button control; revolutionary design of plug-in recording/reproducing and erasing heads, giving a recording range flat within ±3 db. from 50-10,000 c.p.s.; silent fast forward and rewind; records at either 3¾ or 7½ in.sec.; twin track recording giving up to two hours' recording from one reel of tape; separate sockets for microphone, radio, recording from disc and remote control; provision for monitoring; tone and volume controls; suitable for A.C. operation only, self-contained; complete with built-in loudspeaker; coloured morocco finished portable case with ivory instrument panel and gilt locks. Weight, 33 lb. (approx.). Valve line-up: EF40, ECC40, EL42 (Output), EL42 (Oscillator), and EM34 (Magic Eye).

THE PORTABLE

GRUNDIG "Reporter"

TAPE RECORDER

Stocks arriving shortly.

For full details, write—

Distributors: TURNBULL & JONES LTD.

SOLE N.Z. FACTORY REPRESENTATIVES: DIRECT IMPORTS (N.Z.) LTD., BOX 72 HASTINGS

measured in the ordinary way with a sine-wave input signal, would produce droop of 10 per cent. in the top of a 50 c/sec. square-wave. Incidentally, this shows how difficult a matter it is to design circuits which will accurately reproduce the wave-shape of square-waves of even moderately low frequencies.

It can readily be seen from the above example, that the square-wave method of testing can be employed when the conventional method would break down altogether. For supposing we had an audio oscillator which would go no lower than 10 c/sec. (and this is a limit below which very few oscillators will function) it would be quite impossible to get even a rough estimate of the response at very low frequencies. If an amplifier is afflicted with motor-boating, the trouble usually manifests itself at such low frequencies that the individual cycles can be counted, either by their sound in a speaker, or by watching the oscillation of the pointer of a meter in the power supply circuit. The square-wave method is virtually the only one by which any alterations in circuit values can have their practical effects checked, at such low frequencies.

Another practical use which can be made of the same principle is in working out the values needed for a coupling circuit which must pass a low-frequency square-wave with no more than a certain degree of droop. Such a case is in an electronic switch for displaying two waveforms on an oscilloscope at the same time. Here, it is often desired to switch two amplifier valves on or off at, say 25 c/sec. It is not permissible to have more than, say, 0.5 per cent. droop in each of two CR circuits, one at the grid and one at the plate of the amplifier stages. The question is, what kind of CR product will be needed in the coupling circuit if this condition is to be met?

To answer this question, another simple formula can be brought in use, namely,

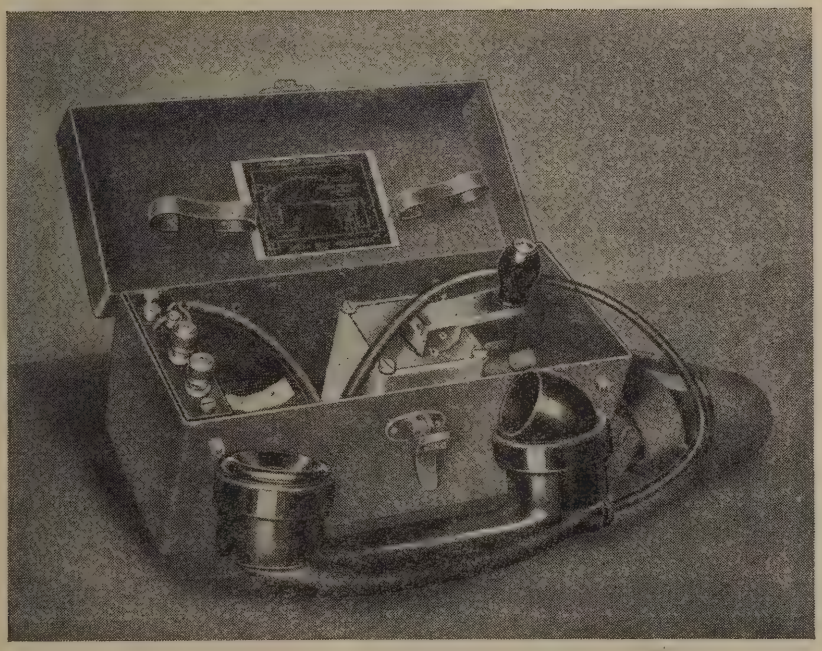
$$RC = \frac{T.E}{x}$$

In this formula, T is the time duration of *one half* of square-wave cycle, E and x are as in Fig. 1 (c), and R and C are the values of these components in megohms and microfarads respectively.

In our problem, T is 1/50 sec., and E/e is 200.

(Continued on Page 48.)

Battery-Less Portable Telephone type L51



The Battery-less Portable Telephone consists of a battery-less handset and high-frequency generator for "howler" calling, both contained in a sheet-metal case, fitted complete with webbing and carrying strap. No batteries are required for speaking or ringing. This instrument requires two-core cable for connection, and is ideal for positions which only require temporary communication.

Manufactured by
TELEPHONE MANUFACTURING CO.
London, England

New Zealand Representatives:

AMALGAMATED WIRELESS (Australasia) LTD.

WELLINGTON: COMMERCIAL BANK BUILDING, LAMBTON QUAY ——— P.O. BOX 830
AUCKLAND: VULCAN BUILDINGS, VULCAN LANE ——— P.O. BOX 1363

Valve Curves and Cathode Biasing

While it is a simple matter to calculate the value required for a cathode resistor, if the required grid bias, and the plate current are known, it is often necessary to find the right value to use in cases where the only information available is a set of curves, such as are published by the manufacturers in the valve data books. A very simple graphical method, described in this article, will enable one to see the effect of using any particular cathode resistor in conjunction with any plate voltage and current.

INTRODUCTION

It is very often necessary or desirable to operate amplifier valves under conditions which are not identical with the "Typical Operating Conditions" given in the valve data books. When this has to be done, the question of the right value of cathode resistor is one that is normally settled only by trial and error. This means building a mock-up of the stage in question, and experimenting with different values. Although this might ultimately be the method used for small final adjustments to the valve's operating conditions, it is essential, in order to save time, and also sometimes to prevent damage to the valve, to have a rough idea of where the first trial value should be. The method described here exactly fulfils these requirements, and will often enable random experimenting with values to be dispensed with altogether. Before we go on to describe the method in detail, let us look at some of the problems that can be solved by its use.

APPLICATIONS OF THE METHOD

A common problem is that of using a valve as a Class A amplifier under certain conditions of plate supply voltage, when the only information given in the valve book are data on operation at one particular plate voltage. The question is, what should be the value of the cathode resistor under the proposed conditions of use? Sometimes, even a single list of typical operating conditions is missing from the data book, and all we have to go on is a set of curves. Even here, the method will give us quite an accurate answer.

Another situation in which the method can be useful is in using a change in the value of cathode resistor from the normal value in order to reduce the plate current of a stage. This can be done if the valve concerned is being run at a lower signal level, and is never called upon to deliver maximum signal voltage or power output.

USE OF MUTUAL CHARACTERISTICS

Sometimes readers have asked us the reason for the inclusion in the valve books of the curves known as the mutual characteristic. This is the set of curves showing the plate current versus grid voltage for a number of different plate voltages, and a typical set is given in Fig. 1. Now in a case where the plate current, and the grid bias to give that current, are both known, all we need to do to find the value of the cathode resistor is to apply Ohm's Law. Thus, if the plate current is 10 ma. and the bias 5v., the required resistor is

$$R = \frac{5 \times 1000}{10} = 500 \text{ ohms}$$

Similarly, if the plate current is 20ma. and the bias

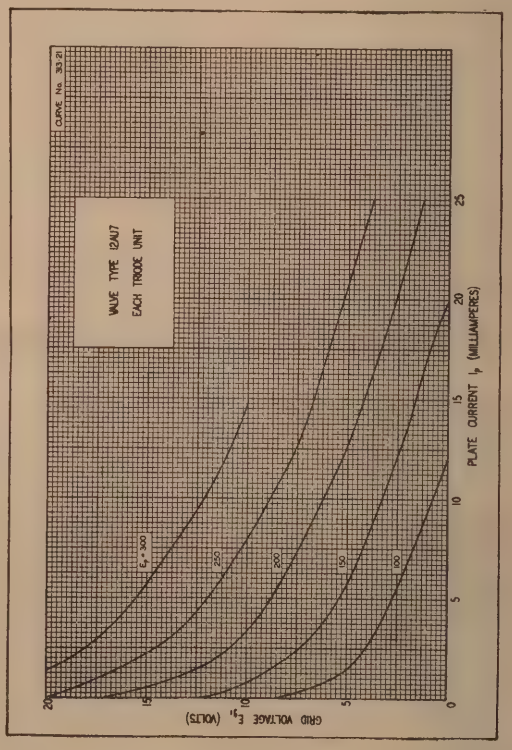


Fig. 1

10v., the resistance needed is exactly the same. If now we look at the graph of Fig. 1, and plot the points representing (5v. 10ma.) and (10v. 20ma.), we find that a straight line through them will pass through the origin of the graph. (The origin is the point (0v. 0ma.) and is the right-hand bottom corner.) Also, if we like to work out any other combination of current and voltage which corresponds to a resistance of 500 ohms, and plot this on the graph we will find that this too comes on the line joining the origin to the other points we have just worked out. From this we can infer that any line drawn on this graph, and passing through the origin, represents a fixed value of resistance. Further, this is quite independent of the valve curves, because on any graph which shows current against voltage, there must be straight lines that can be drawn to represent given values of resistance. In other words, if we rubbed out the valve curves, leaving only the calibrated voltage and cur-

rent axes, the straight lines through the origin would still represent values of resistance.

How, then, do these lines tell us anything about the action of the valve? The answer is that *where they cut the valve curves*, the cathode resistor load lines, as we can rightfully call them, tell us the grid bias and plate current that the valve will have if provided with a cathode resistor of the value represented by the particular cathode load line we are following. In case this might be a little difficult to visualize, the following explanation might prove helpful.

The valve curve for, say 250 volts at the plate, shows the manner in which the plate current will vary when the grid voltage is varied. Thus with 250 volts on the plate, the point at which the valve operates must lie on this curve. Now we saw earlier that all points on the graph which show the behaviour of a certain cathode resistor lie on a straight line through the origin. Therefore, if the 500-ohm resistor is in the cathode circuit, so that the plate current flows through it, and so that the voltage developed across it is the grid bias of the stage, the latter *can only operate at the point where the two curves meet.* For instance, take any point anywhere else on the graph. If it does not lie on the valve curve, then it represents a current and grid voltage that the valve *cannot* have simultaneously, unless the plate voltage is changed. Similarly, if the point is not on the cathode load line for the selected value of cathode resistance, such a plate current cannot flow at the grid bias represented by the point. Therefore, if both conditions are to be satisfied at the same time, the operating point must lie on BOTH the valve curve for the chosen plate voltage AND the cathode load line for the chosen resistor. The only point on the graph which satisfies both conditions is the one where the two lines cross.

Now let us consider how the cathode load line can be used in actual practice. Suppose (Fig. 2) that we are to put 250 volts on the plate of the valve. We can thus select the appropriate curve, ignoring all the

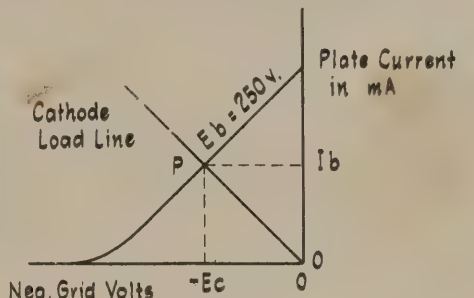
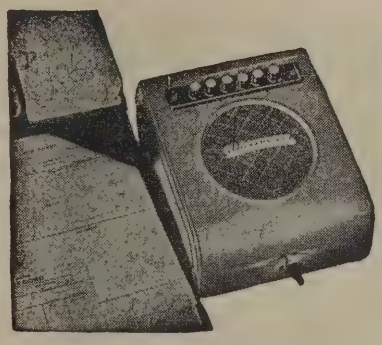
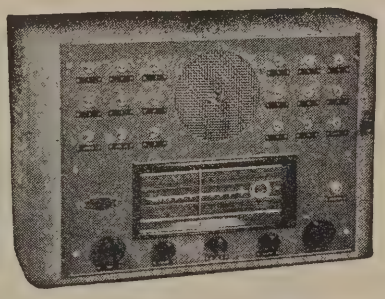


Figure 2

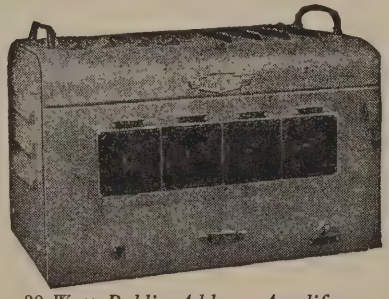
others, which, once the plate voltage is chosen, have no significance. The valve is to be a transformer-coupled amplifier, which means that the curve will actually represent the plate current at all grid voltages from 0 to cut-off. We want to find the best value of cathode resistor. Now it is well known that the greatest output voltage, and usually the least distortion


Executive Intercommunicator


Sound Systems for Schools

ULTIMATE
Industrial Communication Systems

Industrial efficiency depends on speed in communication. Of necessity, each installation requires its own design, and Ultimate's skilled technicians, with many years of experience, are fully qualified to advise on your particular problem. Write for further information on Ultimate's Communication Specialties


30-Watt Public Address Amplifier

Recording Control Equipment

Manufactured by CS4.

RADIO (1936) LIMITED QUAY STREET AUCKLAND

too, will be obtained by operating the valve at that point on the curve which is centrally situated on the centre of the straightest portion. The operating point can then be chosen in this way, at the point P on Fig. 2. Then, the cathode load line will be OP, and the value of the resistor will be found from

$$R_c = E_c/I_b$$

where E_c is the negative grid bias corresponding to the point P, and I_p is the plate current corresponding to the same point.

Another problem which can be investigated is the probable effect on the output voltage and distortion if the plate voltage changes to some other value, as it is sometimes likely to do, owing to changing mains voltages, regulation of the power supply, etc. The other valve curves, for different plate voltages, lie roughly parallel with the one illustrated, especially at the part which is almost linear. Lower plate voltage curves come to the right of the one shown, while higher ones lie to the left, and therefore also above. Thus, we can easily see that if the plate voltage falls, and the bias resistor remains unchanged, the operating point P on the new plate voltage curve will be at a lower point on the new curve, nearer to the bottom bend. Thus, the negative half-cycles of the input signal are likely to be distorted, and to regain maximum possible undistorted output voltage, the correct thing to do would be to reduce the grid bias. This will allow the plate current to be increased slightly, bringing the operating point nearer to the middle of the straight portion of the new plate voltage curve. The new operating point will be above the old cathode load line OP, and will therefore indicate that an increase in cathode bias is needed. From general principles, this might have been predicted, because reducing the plate voltage reduces the plate current, which in turn reduces the bias. With cathode bias, this automatic regulation effect helps considerably, because the operating point would not shift nearly so badly as it would with fixed bias. The effective difference can be gauged from the vertical dotted line at $-E_c$ on the graph. A shift to a new and lower curve will cause the tube to be badly over-biased—much more than when cathode bias is used. This is what the books mean when they say that self-bias has an automatic compensating effect for changes of supply voltages.

RADIO AND ELECTRONIC COMPONENT TRENDS

In the construction of TV and radio receivers for the home, 90 per cent. of the products of British component firms were used before the war. Today, only 40 per cent. of the components are used in this way. 25 per cent. are exported, while radar, communication equipment and industrial electronic apparatus generally account for the remainder.

A "nonode" is the name given to a new British valve which can be used as a detector for both frequency and amplitude modulation.

New miniature electrolytic capacitors have been made which have working temperatures of 85-120 degrees C. according to the type.

A new type of gram pick-up tracks as low as 20 c. and with a predetermined needle-point pressure of 7.5 grams, for all types of record.

WAR SURPLUS ELECTRONIC EQUIPMENT

★

We have for disposal residues of certain War Surplus Electronic Equipment, which are being offered at attractive prices.

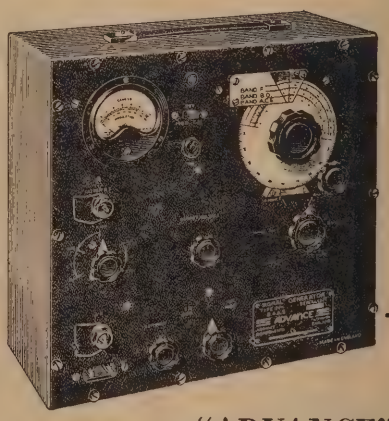
★

Write for details to:

W. G. LEATHAM LTD.

P.O. BOX 1284 ——— WELLINGTON

Telephone 43-314



"ADVANCE" SIGNAL GENERATOR B.4

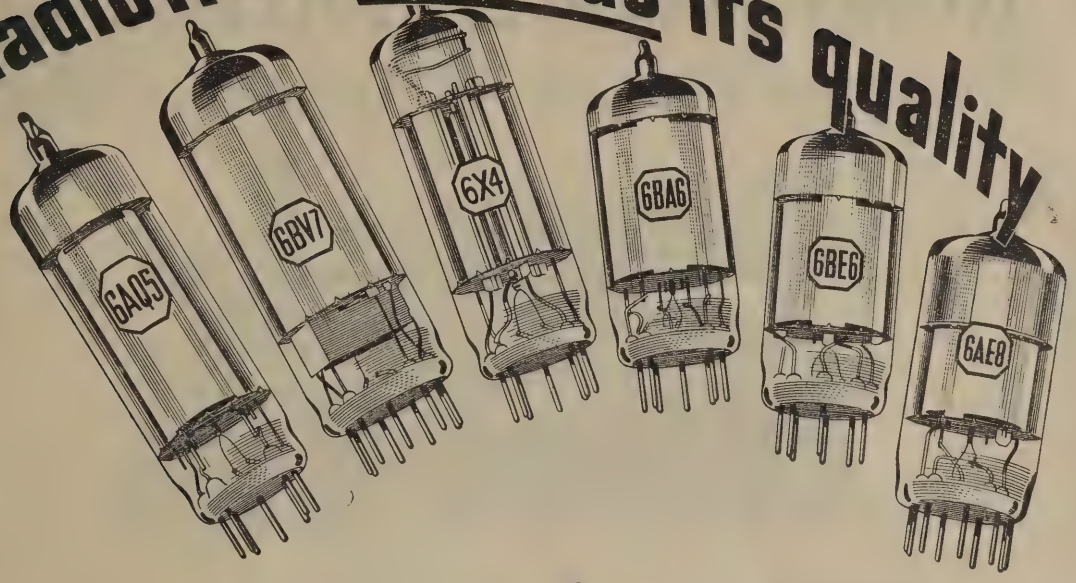
A SUB-STANDARD SIGNAL GENERATOR BY "ADVANCE." FREQUENCY RANGE COVERS 100 Kc/s. to 70 Mc/s. (MODEL A) or 30 Kc/s. to 30 Mc/s. MODEL B). ACCURATE TO ± 1 db.

Price £96

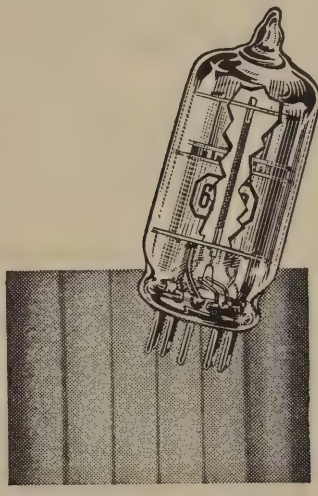
SWAN ELECTRIC CO. LTD.

Auckland Wellington Christchurch

Radiotron in-builds its quality



Only by extreme attention to detail in all stages of manufacture can the ultimate in life and performance be attained. The uniformity of Radiotron characteristics is assured by excluding impurities from raw materials, precision fabrication of valve parts combined with highly efficient assembly techniques against a background of twenty years' experience.



A striking example of A.W.V.'s painstaking methods is the manufacture of sprayed cathodes. The accompanying microphotograph ilustrates the different types of cathodes used in RADIOTRON Valves. The smooth high-density coating is used in close-spaced rectifiers, and the rougher coatings are for use in power output valves.

This coating surrounding the nickel cathode sleeve is initially a mixture of alkaline-earth carbonates, barium, strontium, and calcium, and is deposited by spraying under quality-controlled conditions.

Desired cathode characteristics demand that the sprayed diameter be kept within ± 0.001 inch at a predetermined density of coating.

This constant attention to detail is one of the many unseen factors contributing to the high quality and top performance of AW.V. RADIOTRON VALVES

AWV

RADIOTRON

VALVES

New Zealand Distributors:

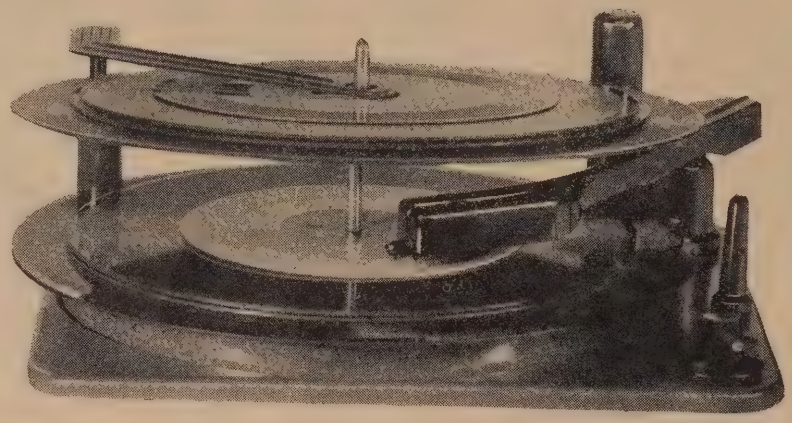
THE NATIONAL NEECO ELECTRICAL AND ENGINEERING COMPANY LIMITED

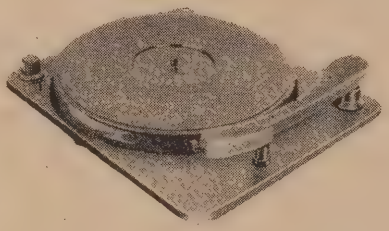
Auckland Wellington Christchurch Dunedin
Hamilton Wanganui Hastings Invercargill

TO-DAY'S GREATEST SUCCESS

The Auto Changer of Tomorrow

BSR





The "Regent"

TYPE GU4A

. . . a beautifully styled three-speed gramophone. Complete with ingenious automatic stop and lightweight high-fidelity turnover type crystal pick-up fitted with two permanent sapphire styli.

The 'Monarch' auto changer

A masterpiece in design and technical excellence—a three-speed automatic record-changer designed to play 12 in., 10 in., and the increasingly popular 7 in. records intermixed in any order. The "Monarch" combines ease and simplicity of operation with the high standard of reproduction and performance demanded by the most discriminating listener.

NOTE THESE SEVEN STAR FEATURES

★ Exclusive new "Magidisk" selector automatically selects and plays 7 in., 10 in., and 12 in. records, intermixed, at 33⅓, 45, and 78 r.p.m. Capacity, 10 records.

★ Pick-up automatically returned to rest position and motor switched off after last record.

★ New reversible dual stylus crystal pick-up has extended frequency range to 10,000 c.p.s. Self-compensated for the L.P. lower frequencies with the turnover frequency at the correct point.

★ Remarkably compact design makes it an ideal unit for the radiogram/TV combination console.

★ Simplicity of design guarantees long life and trouble-free operation.

★ Beautiful styling and finish that will harmonize with any cabinet design.

★ Operates on 100/125-200/250 volts, 50 cycles A.C. Models also available for 60 cycles A.C.

E.M.I. SUPPLIERS

(Trade Division of H.M.V. (N.Z.) Ltd.)

162-172 WAKEFIELD STREET, WELLINGTON

C.P.O. Box 296 **Phone 54-890**

The "RADIO and ELECTRONICS" Abstract Service

AERIALS AND TRANSMISSION LINES

The surface-wave transmission line, sometimes known as the "G String", was developed around 1950 for the U.S. Signal Corps. In 1951 considerable attention was given this development through the medium of military publications. The SWTL as it is called is a single conductor wave-guide which can be cheaply produced, and which is simple to install. The "G String" consists of nothing more than a copper wire connected to the inner conductor of a coaxial panel, about which is placed a cone whose open end is directed towards the running end of the copper wire.

—*"CQ"* (U.S.A.), April, 1953, p. 13.

AUDIO EQUIPMENT AND DESIGN

A recently developed process has made it possible to add a fine strip of magnetic coating to the sub-standard movie films, allowing a sound trace to be provided with the same facility as recording on ordinary tape. It is anticipated that magnetic "stripping" facilities will become available (in Australia) within a few months.

—*Radio and Hobbies* (Aust.), July, 1953, p. 23.

The electrical synthesis of musical tones: the apparent ease with which it is possible to produce sustained tones from valve oscillators has led to the publication and marketing of some circuits which fall short of even the minimum requirements for aesthetic tolerance. The article illustrates the relationship between frequency, amplitude, and intensity, and general theory in relation to music. This is an interesting study of how musical tones are formed.

—*Electronic Engineering* (Eng.), July, 1953, p. 278.

The lateral mechanical impedance of a phonograph has come to be regarded as one of its most important characteristics, as this determines the tracking capacity of the pick-up and consequently the record and stylus wear and the tracking distortion. Notable improvements have been made in pick-ups during recent years through the reduction of such impedance. The actual measurement of mechanical impedance has, however, been a difficult matter. Techniques have been devised, and are described, for measuring the impedance between 30 and 10,000 c.p.s.

—*Audio Engineering* (U.S.A.), June, 1953, p. 24.

A very good article is provided on the band-pass of a transformer-coupled amplifier. It is the purpose of the article to furnish a rapid reading calculator for the one and three decibel attenuation frequencies. The calculator may be used to select combinations of circuit parameters which afford a specialized bandwidth.

—*Ibid.*, p. 24.

ELECTRONIC DEVICES

In modern methods of estimating projectile velocities the projectile is fired through two large coils separated by a distance of the order of feet, and the resulting disturbance generates an E.M.F. in each coil. Electronic methods are then used to measure the time interval. The article deals with the recurrent sweep chronograph. This is a display type of instrument which traces the gun signals on a C.R.T. surface raster, and superimposes a time measuring matrix.

—*Electronic Engineering* (Eng.), p. 282.

Radio telemetering involves the measurement of physical and electrical quantities and the transmission of this information over a radio link. It is used to obtain information about the behaviour of vehicles—missiles, etc. Such systems are thus simply specialized communication channels involving the translation of the quantity to be measured. The article deals with the many various types of systems now in use.

—*Proceedings of the I.E.E.* (Eng.), Part III, March 1953, p. 4.

How electronics control guided missiles; new weapons nearing the production stage anticipate the era of push-button warfare. Details of V2 control systems illustrate how servo loops correct trajectory and the flying positions of the missiles.

—*Electronics* (U.S.A.), July, 1953, p. 137.

A description of the flying spot microscope. A greatly reduced image of the flying spot on the scanner tube is projected on to the microscope specimen mounted on its slide. As this image of the spot is very small, the specimen may be scanned by the spot and by means of a multiplier tube the image is converted to a video picture giving a bright projection of the specimen. A counting device is also included for cell counts, etc. Many advantages are shown to exist for this form of microscope.

—*Ibid*, p. 137.

INSTRUMENTS AND TEST GEAR

There is an old saying, "If it can be measured it can be fixed." Much of the behaviour of high-frequency equipment can be evaluated by measurement of the D.C. in the circuits. If equipment is available to measure D.C. voltage, resistance and low frequency A.C. voltage, not only the D.C. and the low frequency A.C. circuits can be kept under control but the high frequency portions of the equipment can also be controlled. The article describes how a rugged meter movement can be made into a sensitive measuring device.

—*QST* (U.S.A.), June, 1953, p. 28.

A description is given of a direct reading frequency measuring equipment which enables precise frequency measurements between 30 c.p.s. and 30 mc/sec. to be carried out in one second. The measuring device itself consists of an electronic counter with a series of dividers. The result of the measurement is indicated on the electronic counter and the knob.

—*Proceedings of the I.R.E.* (U.S.A.), July, 1953, p. 797.

A problem in the choice of test leads for measuring instruments: the article deals with a question that may easily be forgotten—the effect of the test leads when measuring A.C. voltages. It is necessary to consider the capacity of the leads themselves if accurate measurements are to be made, and to estimate the effects on the final result.

—*QST* (U.S.A.), June, 1953, p. 47.

MATERIALS, VALVES, TRANSISTORS AND SUBSIDIARY TECHNIQUES

The article deals with a cold cathode high voltage rectifier tube which was developed as a part of a project of electron trapping devices. The trapping is produced by the combination of electric and magnetic fields and is similar to that which occurs in the magnetron. It results in an electric discharge resembling a glow discharge but differing from it in that a magnetic field is required to maintain it. Experimentally, the rectifier has been operated up to 40 kw peak voltage. The valve is cold cathode with currents up to 1 ma. and is specially suited for high voltage requirements.

—*Proceedings of the I.R.E.* (U.S.A.), July, 1953, p. 818.

Interesting facts about magnetostriction and its uses in electronics. Recent developments in the field of mechanical resonators may foreshadow increasing applications in our amateur gear, especially in high-selectivity receivers and single-sideband filters. The article deals with the general principles—ferrite resonators, ferrite oscillators, the effects of bias and crossed fields, etc.

—*QST* (U.S.A.), June, 1953, p. 24.

RECEIVERS

A high selectivity device for the receiver: the method discussed is applied to the audio end of the receiver and is a simple and inexpensive means of eliminating an interfering signal. This is a revised gadget first described in 1939, and consists of three variable resistors, two fixed resistors, two paper condensers, a headphone plug and jack. The idea is to zero beat the interfering signal with a local signal so that it can no longer be heard. The gadget described can deal with more than one interfering signal on the lines described.

—*Ibid*, p. 22.

TRANSMITTERS AND TRANSMITTING

For students confused with the terms "modulate," "heterodyne," "beat," "convert," and "mix", the writer gives an excellent explanation showing that they really mean the same thing, and this without graphs or mathematics. The article will clear most of the fog that beginners have about modulation. The article also deals with single-sideband transmission which seems so difficult to understand.

—*Ibid*, p. 15.

An important part of the modern single-sideband transmitter is the part in which the sideband is generated and placed in its proper frequency relationship to the assigned carrier frequency. The phasing rotation method receives special mention, and in some ways it is inferior to the filtering system as the balance of the system is difficult to maintain. The design of a high-powered transmitter is given in detail.

—*Proceedings of the I.R.E.* (U.S.A.) July, 1953, p. 797.

MISCELLANEOUS

How to live longer: a goodly number of hams have met their deaths at the hands of their own equipment, which is very regrettable. The article concerns the things that every operator should observe in building and operating the equipment with a minimum of danger to himself and the rest of his household.

—*QST* (U.S.A.), June, 1953, p. 18

The PHILIPS Experimenter

An advertisement of Philips Electrical Industries of N.Z., Ltd.

No. 72: Circuit and Wiring Considerations When Using High-gain Valves At High Frequencies

Reprints of these EXPERIMENTER articles, complete with illustrations, will be mailed to any address for one year for a subscription of 5s. Application should be made to Technical Publications Department, Philips Electrical Industries of New Zealand Ltd., P.O. Box 2097, Wellington.

INTRODUCTION

In these articles we have always been at some pains to present not only circuits which, electrically, can be expected to give a certain performance in relation to their practical purpose, but also to show, in so far as can be done with photographs and layout diagrams, suitable methods of constructing those circuits.

This policy has been dictated by the fact that there are two parts to the design of any equipment using valves; the electrical circuit diagram is only one portion of the whole, and unless it is applied in the correct mechanical way, the characteristics of the circuit will not necessarily be realized in practice. Particularly is this true of amplifiers using high-gain valves at high frequencies. The performance can be vastly influenced by small changes in physical layout or construction, so that it is hardly too much to say that sometimes, the circuit diagram can mean nothing UNLESS the corresponding physical form of the equipment is rigidly specified.

The state of affairs described in the above paragraphs comes about mostly on account of the fact that at high frequencies, a theoretical circuit diagram leaves out many "components" which are not actual inductors or capacitors, placed there as such by the constructor, but which are nonetheless real in their effects on performance. The purpose of this article is to illustrate some of these things, and to show how, in practice, high-frequency amplifiers may be made to behave in accordance with their theoretical diagrams, and not, for example, to function as multi-stage oscillators instead!

CIRCUIT CONSIDERATIONS

High-gain high-frequency amplifiers include not only multi-stage amplifiers, such as are used in the I.F. sections of television and radar receivers, but also signal-amplifier stages in superhet. receivers of all kinds. Consequently, many of the following remarks apply quite universally to H.F. amplifiers or individual stages, whatever their purpose.

Perhaps the most important question is that of stability. This is far more than simply the avoidance of undesired oscillation, since for some purposes, an amplifier may have insufficient regeneration to make it oscillate, and yet be regenerative enough completely to spoil it for its chosen purpose. A typical example of this is the whole signal section of a television receiver, which must not only act as a stable amplifier, but must have an accurately specified shape of response curve. Undesired regeneration, while yet too little to cause oscillation, can easily prevent the required response curve from being obtained, with disastrous results in terms of picture quality. To take a further example, it is well known that regeneration in low-level amplifier stages of high-gain receivers degrades the signal-to-noise ratio. This is of the utmost importance in H.F. and especially in V.H.F. communications equipment. Other examples could be given, but these two serve to underline the extreme importance of *complete* stability. Many people who build receivers may realize this to some extent, and yet fail to produce stable receivers or amplifiers through lack of appreciation of the factors influencing stability.

For example, it is often not realized that at a given frequency, and with a given valve type, there is a maximum stage gain that can be expected before regeneration becomes excessive. This maximum allowable gain will vary, for a given valve, according to the use to which it is put. Clearly, it will be greatest if the essential condition is merely that the stage shall not oscillate. However, if the condition is that the response curve shall not be distorted, much less regeneration can be tolerated. It should be clearly understood that the regeneration of which we are speaking at the moment is inherent in any stage, and is not neccesarily a function of improper construction, because it is the feedback from plate to control grid through the grid-plate capacity, exactly similar in kind to that which prevents an unneutralized triode from functioning as a tuned amplifier. Because R.F. pentodes have an exceedingly low grid-plate capacity, they are often regarded as if this was completely non-existent, and this is where the difficulty comes in. The pentode construction does not remove grid-plate capacity altogether. It merely reduces it considerably. As a result oscillation *can* occur when the valve is used with tuned grid and plate circuits. It will occur if the mutual conductance of the valve is great enough in relation to (a) the reactance of the grid-plate capacity, and (b) the parallel impedance of the tuned circuits. Thus, at a given frequency, when the reactance of C_{gp} is constant, and with a given valve, whose mutual conductance is also constant, the amplifier will be stable provided the dynamic impedance of the tuned circuits does not exceed a certain critical value. If that value should be exceeded, the stage will oscillate. This is the reason why it is not, in general, possible to use modern high-Gm valves at medium frequencies, with tuned circuits having the same characteristics as those used in broadcast receivers. The above paragraph should be of great assistance to those who have difficulty with oscillating amplifier stages, since they point the way to suitable remedies. Provided that it is only a single stage that is oscillating—and this can be proved by pulling all the other valves, there are two cures that can be applied. One is to use a valve with no greater grid-plate capacity, but smaller Gm, and the other is to shunt resistance across the tuned circuits. Which method is used in a given instance will depend on

whether selectivity or gain is the more important. It cannot be emphasized too strongly that single-stage oscillation is quite independent of anything else in the receiver or amplifier. It may be that other causes of instability exist, too, and that after the single-stage oscillation has been cured, the whole is still unstable, due to feedback

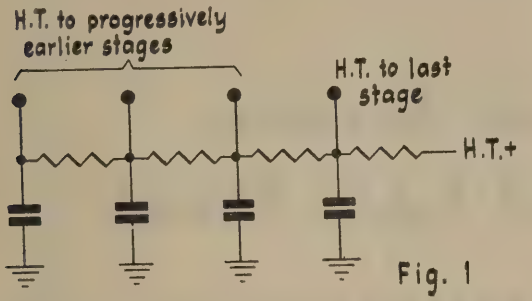


Fig. 1

around more than one stage. If this is found, then the single-stage instability should be cured first, after which remaining instability will have to be cleared up by improving the layout of the whole amplifier, or by better decoupling between stages, whichever is found to be the cause.

In treatises on multi-stage amplifiers, the importance of decoupling each stage from the power supply leads is usually stressed, as it should be, because if the power supply has some impedance at the signal frequency, then a signal voltage will be developed across this impedance, and any amplifier having more than two stages will be coupled regeneratively. Two stages only, will be coupled

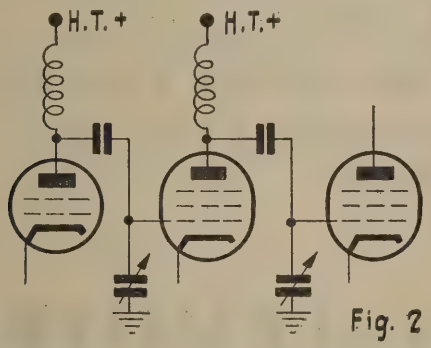


Fig. 2

degeneratively by this means, but it is still important that the coupling should be removed, even though in this case it cannot cause oscillation. To do this, it is necessary to use separate screen dropping resistors and cathode resistors for each stage, where these components are used at all. Similarly, it is advisable to insert decoupling filters in the H.T. lead to each stage. For high frequencies, the resistors need only be of the order of 2000 ohms, with bypass condensers of from 0.01 to 0.05 μf. The usual method of decoupling the plate circuits is to take each decoupling circuit to the H.T. line independently of the other, but improved decoupling can be obtained by feeding each stage from the output of the following stage's decoupling filter. The complete decoupling circuit then looks like that of Fig. 1. The only disadvantage of this arrangement is that those stages at the end of the chain receive less H.T. voltage than the later stages, but since the resistors can be small, this rarely causes difficulty in practice, provided the earlier stages are at the lower end of the chain. These stages need less H.T. voltage, because they are carrying only small signal voltages. The arrangement ensures that the degree of decoupling increases the earlier a stage is in the amplifier.

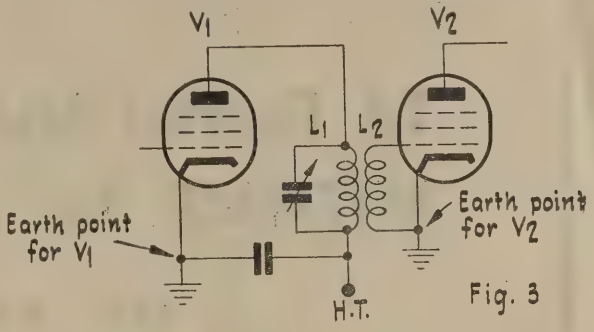


Fig. 3

While we are discussing circuit arrangements, we would like to point out one commonly used circuit which is not as good in multi-stage amplifiers as others. It is the one shown in skeleton form in Fig. 2. Here, single tuned circuits are employed between stages, and series feed is used for providing H.T. voltage to the valves. Now it is commonly recommended that in multi-stage amplifiers, all earth returns belonging to one stage should be taken to a single point on the chassis, in order to prevent R.F. currents from flowing in the latter. These, if they exist, can be a prolific source of undesired coupling between stages, and can therefore cause instability. Now with the series-fed arrangement of Fig. 2 it is not possible to keep R.F. currents out of the chassis, because of the stray capacity associated with the grid circuit of the driven stages. This capacity forms part of the tuning capacity of the circuit, so that the R.F. return currents flow partly through the intentional tuning capacity, if any, and partly through the grid-cathode capacity of the next tube. One way of avoiding this is shown in Fig. 3, where instead of a single winding, two very tightly-coupled windings are used. The untuned one is in the grid circuit of the following stage, while the tuned one is earthed at the preceding stage. In this circuit, we have two tightly-coupled tuned circuits, each returned to its own stage. From the point of view of performance such an arrangement is identical with that of Fig. 1, and is obtained in practice by winding the coil with two wires, side-by-side on the former. This is known as bifilar winding. Separately tuned transformers, similar to conventional I.F. transformers behave in the same way as Fig. 3 as far as circuit decoupling is concerned, because each winding's "cold" end can be bypassed to its own stage. With Fig. 2, however, there are R.F. chassis currents, to whichever earth point the coil is returned.

WIRING CONSIDERATIONS

In the mechanical design of R.F. and I.F. amplifiers many factors must be taken into consideration if the best performance is to be realized. At frequencies above 20 to 30 mc/sec., leads even $\frac{1}{4}$ in. in length form appreciable reactive elements, and due allowance must be made for these when the various circuit values are being calculated. Although every attempt is usually made to keep leads as short as possible, this cannot be pursued indefinitely, as the mechanical layout of the amplifier

(Continued on Page 31.)

TO: Electrical Appliance Servicemen

REFERENCE: Iron and Toaster Elements

FIT 'PACEMAKER' Replacement Elements in iron and toaster repairs and BUILD YOUR REPUTATION for good servicing!

Made in both clear Mica and Australian Mica . . . ALL TYPES available from stock. There's NO BETTER VALUE in iron and toaster elements than "PACEMAKER"!

FULL DETAILS FROM . . .

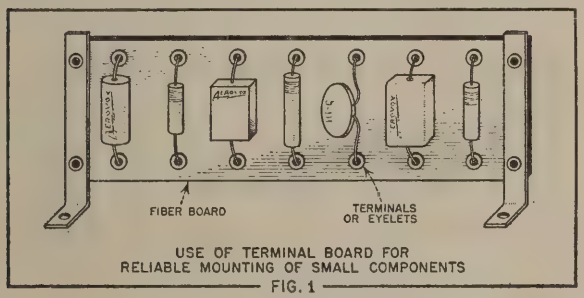
H. W. CLARKE (N.Z.) LIMITED

AUCKLAND WELLINGTON
CHRISTCHURCH DUNEDIN

Proper Electronic Wiring Techniques

By the Engineering Department, Aerovox Corporation

The old adage that warns that "a chain is no stronger than its weakest link" is nowhere truer than in the art of electronic wiring. Especially in today's advanced circuitry, where *ruggedization* and *reliability* are the keynotes, proper wiring is a prerequisite. Where the destination of a guided missile, the proper functioning of an airport blind landing radar equipment, or the final answer of an electronic computer, may depend upon any one of thousands of tiny soldered connections, meticulous attention must be paid to such small details. Even in the research and development field, it is impossible to estimate how many important experiments may have failed because trivial circuit troubles masked the desired results.



USE OF TERMINAL BOARD FOR RELIABLE MOUNTING OF SMALL COMPONENTS

FIG. 1

And in less glamorous applications, such as the telephone industry and the radio and television manufacuring and servicing fields, the extra effort expended in producing dependable wiring has been found to pay dividends. For these reasons, a working knowledge of the proper methods of producing a neat, dependable wiring job are required of every technician and engineer in the field of electronics.

The basic steps in wiring an electronic device are essentially the same regardless of whether the unit is an entire telephone central office or an A.C./D.C. midget radio chassis. They are:

(a) Mounting the circuit components.

(b) Wiring and cabling.

(c) Connecting and lead dress.

(d) Visual inspection.

(e) Electrical inspection.

This article discusses these wiring operations in some detail, with special emphasis on (b) and (c).

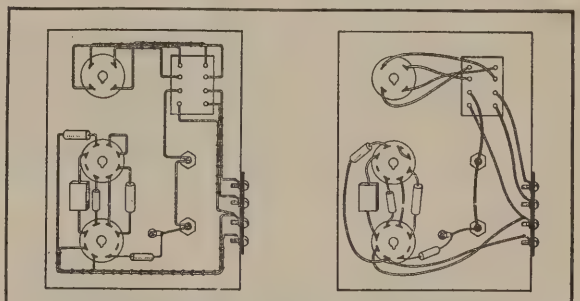
MOUNTING CIRCUIT COMPONENTS

Here it is assumed that the circuit layout has been engineered so that the components are located in the unit in positions which give short lead lengths for critical circuits, minimize the effects of hum fields radiated by chokes and transformers, and places temperature sensitive components in the most desirable environmental locations. This layout is usually arrived at by using a "mock-up" of the unit and parts and moving the parts around until a suitable arrangement is found. The layout engineering should also provide for the use of the components which have the most suitable terminal arrangements for that particular job.

When all parts have been located, the chassis holes required to mount them are drilled or punched. For reliability, all parts except small capacitors, R.F. chokes, and resistors which are light enough to be self-supported on their wire leads must be securely fastened to the chassis. Strip-type terminal boards of the kind illustrated in Fig. 1 are useful for mounting such small components. All other components must be securely attached to the chassis. Where wires must go through metal panels or chassis, the holes should be suitably insulated. Rubber *grommets* are used for low voltage leads and ceramic *feed-thru* insulators are employed for high voltage circuits. These precautions improve the reliability of the circuit by providing additional electrical insulation and prevent the rough edges of the hole from chafing the wire insulation.

WIRING AND CABLING

When all circuit components are mounted, the unit is ready for wiring. If the unit is a one-of-a-kind wiring job, the wires may be run individually from one terminal to another, working from the wiring diagram. The routing of the wires depends upon the nature of the circuit, the permanence of the wiring, and the allowable cost of the job. In low-cost production wiring, such as is found in broadcast receivers and television sets, direct point-to-point wiring is employed, without much regard to appearance. In "custom" wired units, such as commercial communication equipment, telephone central office equipment, and quality audio equipment, all wiring and component parts are kept parallel to the sides of the chassis, so that the finished job presents a neat, "right-angled" appearance. Where groups of wires take the same path, they are "cabled" or laced" together with waxed cord. The comparison between a chassis wired in this manner and one in which point-to-point wiring is employed, is shown in Fig. 2.

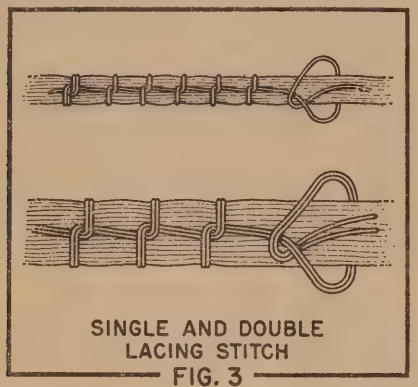


COMPARISON BETWEEN "CUSTOM" AND "STANDARD" WIRING

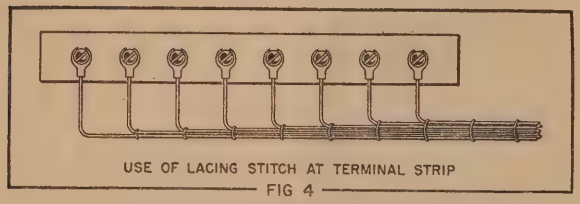
FIG. 2

The proper use of the techniques of lacing wire forms is a sure mark of the skilled wiring technician. The lacing stitch illustrated in Fig. 3 is standard throughout the Bell System and is simple and efficient. Note that the parts of the lacing cord which run parallel to the wires emerge from *under* the part that encircles the wires. This stitch is self-locking and will remain tight even when the stitches on either side of it are cut. Wire forms which run from one chassis to another in a relay rack, as well as within-the-chassis wiring, present a much neater appearance and are stronger and more dependable if laced together in this manner to form a compact cable. Lacing also provides an index to the

proper location of wires on a terminal strip or other circuit component by "breaking-out" each wire at its proper location with a separate stitch, as illustrated in Fig. 4. This allows the wires to be disconnected at any future time and subsequently returned to the proper terminals.



SINGLE AND DOUBLE LACING STITCH
FIG. 3



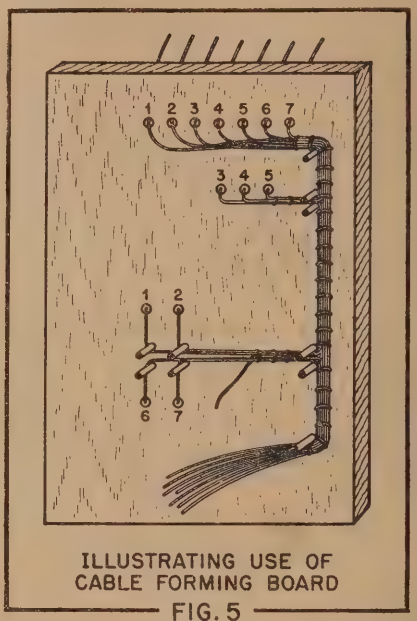
USE OF LACING STITCH AT TERMINAL STRIP
FIG 4

If more than one unit of a kind is to be wired with cabled wires, or if an especially neat job is desired, the production technique of using a "forming board" is employed. This consists of a large wooden board (Fig. 5) on which pegs or nails are laid out to represent the shape the laced wire form must take. Holes may also be drilled through the board at the location of each terminal to which the wires must be connected. The location of bends and terminals on the forming board are determined by carefully measuring the corresponding distances between the components in the chassis or between chassis. Then the individual wires are run between the proper points on the board as indicated by the wiring diagram. Unskilled labour can perform complex wiring in this manner with few mistakes, since the forming board can be clearly marked with numbers or colour coding to indicate the proper points of attachment for each wire as well as its proper routing and sequence in the wiring operation. The end of each wire is anchored on the board by wrapping it around a nail or peg placed in a position representing the location of the terminal it will ultimately be connected to. Enough excess should be allowed to permit stripping the insulation to the proper length. If holes are used in the board to "fan" the wires through at the desired locations, the points of attachment will be on the back side of the forming board.

When all of the wires have been run on the forming board, they are cabled together while still on the board. Here they are usually more accessible than in the chassis, making for a faster and neater job. The wires may also be stripped of their insulation and readied for connecting after the cabling is completed so that they are held firmly in the positions they will assume in the chassis.

CONNECTING AND LEAD DRESS

Connecting is the operation of electrically attaching the wires to the component terminals. The type of connection employed depends on the kind of terminals



ILLUSTRATING USE OF CABLE FORMING BOARD
FIG. 5

FLY
ACROSS COOK STRAIT
with
YOUR CAR

If you are planning a trip to the other Island and need your car, ring the local railway station for a booking by RAIL-AIR.

RAIL-AIR will fly you and your car between Paraparaumu and Blenheim in 30 minutes; between Paraparumu and Nelson in 45 minutes. No delay, no damage . . . if you wish, you may drive your car on and off the plane yourself.

During the Christmas and New Year Holidays, when surface transport is congested, RAIL-AIR will take your car across Cook Strait!

★ RAIL-AIR ★

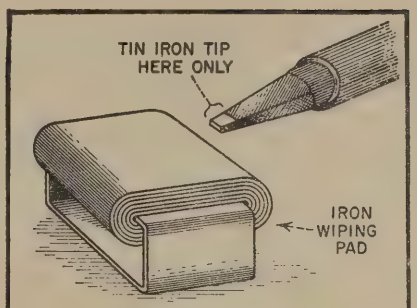
Inquire Today About the *Modern* Inter-Island Car Ferry

provided on the circuit components. These may be binding screws, soldering lugs, or directly soldered connections. Soldering in some form is employed in all of these methods but in none of them should the strength of the joint depend upon the strength of the solder. A firm mechanical attachment must be made between the wire and the terminal which is independent of the solder.

In the binding screw type of connection where soldering lugs are not used, the wire should be "tinned" with solder and then formed into a *clockwise* loop around the screw, so that it will tighten as the screw is tightened. If soldering lugs are used, the grippers on the lug are crimped around the insulation on the wire for mechanical strength and the bared tip of the wire is soldered to the lug. For directly soldered connections, the well-cleaned wire is wound once around the pre-tinned terminal for strength before soldering. Winding the wire around the terminal more than once usually makes subsequent removal of the connection difficult.

The main secrets of producing good soldered connections are the preparation of the joint to be soldered and the maintenance of the soldering iron. Of course, the materials used play an important part also. Tinned wire of the "push-back" variety should be used where possible for ease of "skinning" and connecting. The solder for all radio wiring should have a resin flux in the core and be a high tin content alloy.

If enamelled wire is used, the insulation must be stripped back and the enamel scraped off to expose the bare metal. Otherwise, a dependable soldered joint cannot be made. The methods used to strip the insulation from hook-up wire depend upon the kind used. Most



PROPER TINNING OF SOLDERING IRON TIP

FIG. 6

types are conveniently stripped by crushing the insulation with long nose pliers and dressing the frayed ends of the diagonals. For the tougher types of insulation, such as the cellulose acetate braided kinds, a stripping tool is required. Care must be exercised to prevent "nicking" the wire during stripping and cleaning, as this frequently results in a broken connection later. As mentioned above, when the wiring is done by running the wires between holes in a forming board, the wires can all be skinned at one time by reversing the board and removing the insulation to the right length.

To produce a clean, dependable soldered connection, the soldering iron must be of a type well adapted to

"PANAMA" Electric Jugs

"Panama" products.

Elegance of design and skilled craftsmanship have been combined to create this new release in the long line of quality

★ Constructed of heavy gauge chromium plated copper.

★ Fitted with plastic base and handle to provide maximum insulation against heat.

★ Specially designed lid which eliminates bubbling and splashing whilst boiling.

★ Element guaranteed for two years.

Distributed by:

CORY-WRIGHT & SALMON LTD.

AUCKLAND WELLINGTON DUNEDIN

the job and carefully maintained. A versatile type of soldering iron tip for general connecting is shown in Fig. 6. The tip should be dressed frequently with a file and tinned while still bright only on the surface indicated in the drawing. The remaining parts of the tip should be allowed to oxidize. An iron tinned in this manner can be used in close places where it is necessary for it to touch other connections without flowing them since the oxide acts as a heat insulator.

The tinned portion of the soldering iron should be wiped on a canvas or leather pad attached to the soldering iron stand before each use. This removes excess solder and "slag" and delays erosion of the tip. This operation greatly improves the quality of the job.

In the actual mechanics of soldering a connection, the professional wireman does not apply the solder to the iron and transfer it to the joint being soldered. Little flux reaches a joint soldered in this manner. Instead, the well cleaned iron is applied to the junction of the wire and terminal until both have been heated to near the soldering temperature. Then the solder is applied between the iron and the connection until it flows freely around the junction. A rotary motion of the wrist which "rocks" the iron tip on the joint will serve to work the solder into the joint. The finished connection should be rounded and smooth and the solder should have a bright, shiny appearance. If the joint is disturbed before the molten solder has solidified, the solder will look dull and "sugary" and must be melted again.

After the wires have been connected, the leads are dressed to improve the appearance of the wiring job. The insulation on each wire is pushed up against the terminal so that no exposed wire is visible. A small amount of slack is left in each wire to facilitate future reconnecting and to remove tension from the soldered joint.

VISUAL AND ELECTRICAL INSPECTION

Before a newly wired circuit is placed in actual operation, it should be subjected to both a visual and electrical inspection so that any wiring errors can be eliminated before the application of operating voltages causes damage to circuit components.

The first inspection should consist of a thorough visual examination of the wiring to detect shorts caused by blobs of solder or loose wire ends between terminals, poorly soldered joints, broken wires or terminals, etc. When such defects have been rectified, the circuit should be given an electrical continuity test with an ohmmeter or lamp or buzzer tester. Short circuits between wires and to ground should be tested for as well as electrical continuity between points indicated as common on the circuit diagram.

CHALFONT
ELECTRIC BED SHEETS
Single and Three-Heat Sizes: 60 x 33, 60 x 51
New Zealand Distributors:
E.M.I. SUPPLIERS
BOX 296
162-172 WAKEFIELD ST., WELLINGTON

Get weaving!

Get weaving on any job and you usually find things spin along right merrily. At least that is our experience at "Auto." Like a very industrious spider we've heard about (cica Robert the Bruce) we refuse to let any project baffle us. Supposing we get a particularly knotty problem (and we DO get quite a few) we get right down to business and before you know it, our battery of automatics are turning out your component parts—precisioned to perfection and right on schedule. If YOU have any production requirements concerning component parts machineable from bar stock—any diameter up to 2¼ inch round section—take a tip from Bruce's spider. Get weaving, and "drop us a line."

AUTO MACHINE MANUFACTURING CO. LTD.
18–20 Nelson Street, Auckland, C.1.
P.O. Box 179. Telephone 31-638 (3 lines).
Telegrams: "Auto."

Philips Experimenter

(Continued from Page 25.)

would become cramped and servicing of the apparatus would be difficult if not impossible. A compromise is usually adopted between unnecessarily long leads and lead lengths which would involve difficulty during mass production of the equipment. .....

The performance of an R.F. amplifier valve is measured in the laboratory on equipment in which every possible care is taken to ensure that the results will not be affected by factors which have nothing to do with the valve. As a result of this technique, figures can be stated which relate solely to the valve, and these figures are the data which are presented to the circuit designer. In special cases, performance figures can also be measured on circuits which are known to have a general appeal. In this case the exact circuit must be defined in detail, but even if this is done it is a difficult task to ensure that all copies of the circuit will have the same performance. It is for this reason that the valve manufacturer is reluctant to issue performance data when the valve is used *in circuits where the layout can influence the results.* It is a better principle to issue data for the valve alone and so provide the circuit designer with basic figures from which he can work.

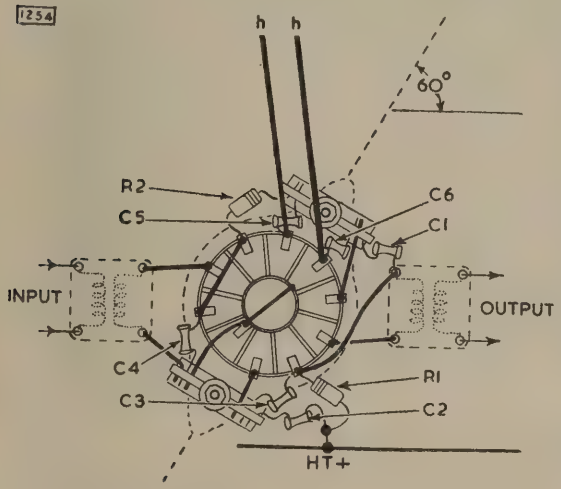


Fig. 4—Recommended wiring layout for base of EF80.

The input damping of a valve when used in a circuit is a quantity which can be considerably influenced by the lengths of the leads connected to the valve-holder. Figures are usually quoted which have been measured for the valve alone: for instance, for the EF80, the input damping is 10,000 ohms at 50 mc/sec.

By way of an example, the layout as shown in Fig. 4 was used, and the effective input damping of the valve was deduced. It was found to be of the order of 3,900 ohms at 50 mc/sec., from which it is clear that a considerable loss had resulted. This loss, relative to the published performance, arises from the inevitable small reactances which have been introduced into the circuit by leads and by the inductive reactances of the decoupling components.

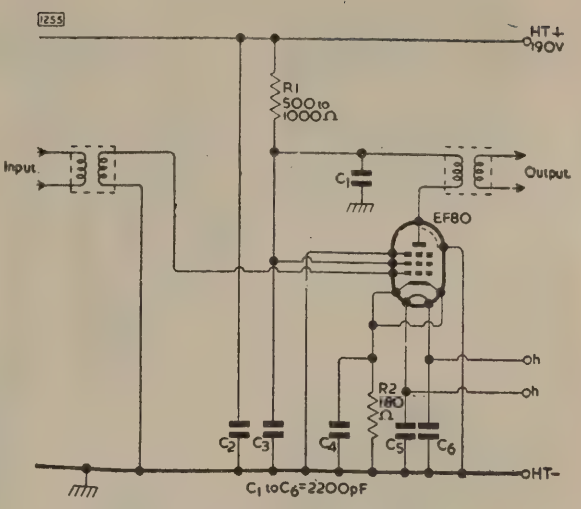


Fig. 5.—Circuit diagram for EF80.

The cathode and screen electrodes should be well decoupled for optimum results. Furthermore, the cathode capacitor can be made to resonate with its own series inductance and the inductance of the cathode lead so as to offer a negligible impedance at the frequency under consideration. This method, however, is likely to depend critically on the type of capacitor used; for instance, the performance with a 500 pF mica capacitor might be different from that experienced with a ceramic capacitor of the same value.

In some cases, it is desired to vary the grid-to-cathode bias of the valve in order to achieve a measure of gain control. Unfortunately, as the gain is reduced, there is a simultaneous increase in the effective parallel input damping resistance. The input capacitance is also reduced in value. In certain cases, therefore, the bandwidth and the resonant frequency of the grid tuned circuit will change as the gain is altered. This effect can be minimized, however, by the introduction of a critical amount of negative feedback in the cathode circuit of the valve. This is usually achieved by leaving a portion of the bias resistor undecoupled. For the EF80 it is suggested that an undecoupled 33-ohm resistor should be connected to the cathode pin of the valve-holder, the remainder of the cathode resistive load, i.e., a 150-ohm resistor, being decoupled to chassis in the usual way. This circuit introduces a loss of approximately 2 db. per stage.

In high-gain amplifiers where several stages are cascaded there is a risk of instability if feedback between stages occurs. The H.T. line and the heater line are two very common causes of this fault. The H.T. line should preferably be decoupled at each take-off point to the individual stages, and a 500–1,000-ohm decoupling resistor for each stage is recommended. The heater line should be decoupled at each valve, and heater chokes may be required for frequencies above 20 mc/sec.

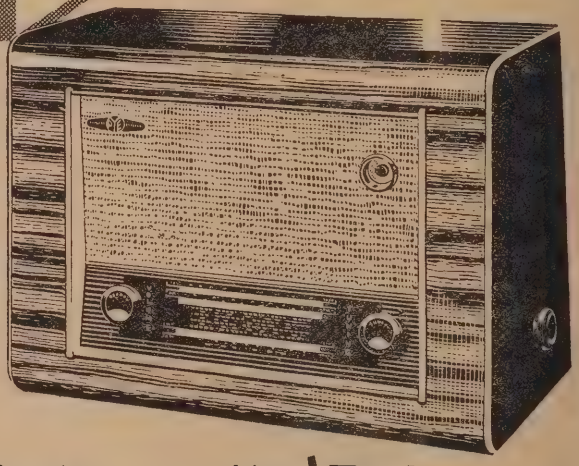
Opinions are divided on the best material to be used for the chassis. There is probably little to choose provided good connections can be made to the chassis. A brushed cadmium-plated steel chassis is known to give good results up to 250 mc/sec. The various leads from the valve and decoupling components to the chassis can

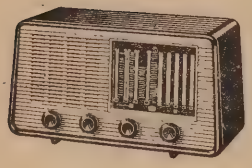
(Concluded on Page 48.)

Model "YRG"
N.I. £69/19/6
S.I. £72/15/0

SELECT FROM THE WORLD'S BEST

5 valve, 5 waveband, BAND-SPREAD Superhet for A.C. Operation. Cabinet in Sapele Mahogany with contrasting grille and dial colours. Fully tropicalised.

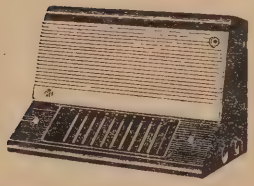




Model "G"
£31/10/0

for only

29'15'0



Model "H"
£55/12/6

Pye Perfection in the '71'

Short-wave BANDSPREADING and a "magic-eye" (for easier, better tuning on short-wave or Broadcast bands); a cabinet of gleaming, rich mahogany; five valves for superb reproduction. These are a few of the features of the outstanding "71"—another Pye contribution to better listening. See the "71" at your Pye dealer today.

Radio and Television

P49.24

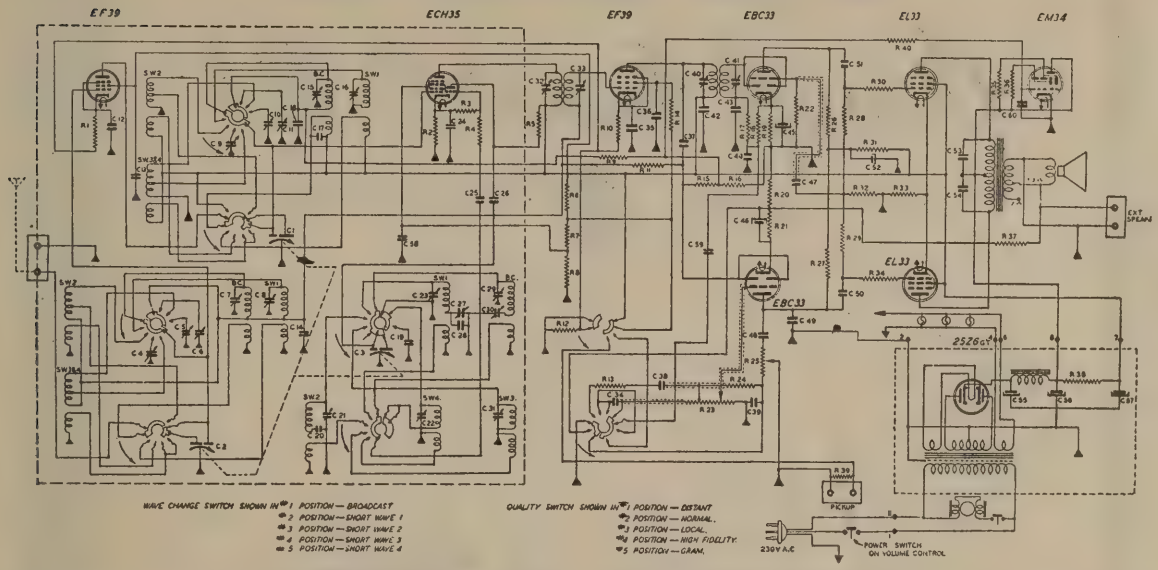
Look for the distinctive PYE trademark at better radio dealers everywhere, or for your nearest PYE Agent, write to:

PYE (NEW ZEALAND) LIMITED.

P.O. Box 2839, Auckland

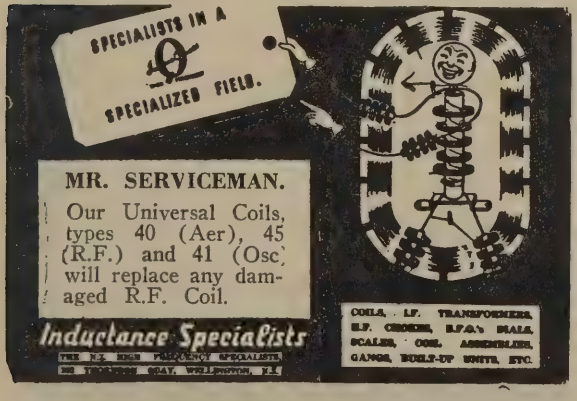
FOR THE SERVICEMAN—Philips Radioplayer Model 601

PHILIPS RADIOPLAYER — MODEL 601



CONDENSER AND RESISTOR VALUES

C1 } 3-gang
C2 } Split Stator
C3 } Tuning Condenser
C4 3-20 mmfd. } Triple
C5 3-20 mmfd. } Trimmer
C6 5-40 mmfd. } Bank
C7 3-30 mmfd. air trim.
C8 3-30 mmfd. air trim.
C9 3-20 mmfd. } triple
C10 3-20 mmfd. } trimmer
C11 5-40 mmfd. } bank
C12 .05 mmfd. 100-400v. paper
C13 .05 mfd. 400v. paper
C14 .05 mfd. 100-400v. paper
C15 3-30 mmfd. air trim.
C16 3-30 mmfd. air trim.
C17 100 mmfd. ceramic
C18 .05 mfd. 100-400v. paper
C19 50 mmfd. negative temperature coeff. ceramic
C20 .0065 mfd. mica
C21 25-150 mmfd. trim.
C22 13-110 mmfd. trim.
C23 3-30 mmfd. air trimmer
C24 .05 mfd. 100-400v. paper
C25 100 mmfd. mica
C26 100 mmfd. mica
C27 450-600 mmfd. padder
C28 .001 mfd. mica
C29 3-30 mmfd. air trimmer
C30 450-600 mmfd. pad.
C31 10-30 mmfd. trimmer
C32 I.F. trimmer
C33 I.F. trimmer
C34 600 mmfd. mica
C35 .1 mfd. 200v. paper
C36 .01 mfd. 400v. paper
C37 10 mmfd. ceramic
C38 50 mmfd. mica
C39 .005 mfd. 400v. paper
C40 I.F. trimmer
C41 I.F. trimmer
C42 .1 mfd. 600v. paper
C43 100 mmfd. ceramic
C44 100 mmfd. ceramic
C45 25 mfd. 25v. electrolytic
C46 25 mfd. 25v. electrolytic
C47 .02 mfd. 400v. paper
C48 .03 mfd. 400v. paper
C49 250 mmfd. mica
C50 .02 mfd. 400v. paper
C51 .02 mfd. 400v. paper
C52 32 mfd. 350v. electrolytic
C53 .005 mfd. 600v. paper
C54 .005 mfd. 600v. paper
C55 40 mfd. 400v. } triple
C56 40 mfd. 400v. } electro-
C57 20 mfd. 400v. } lytic
C58 .05 mfd. 400v. paper
C59 .001 mfd. 400v. paper
C60 .05 400v. paper
R1 200 ohms ½ watt
R2 200 ohms ½ watt
R3 50,000 ohms ½ watt
R4 200 ohms ½ watt
R5 25,000 ohms ½ watt
R6 100,000 ohms ½ watt
R7 25,000 ohms ½ watt
R8 47,000 ohms ½ watt
R9 2 megohms ½ watt
R10 330 ohms ½ watt
R11 2 megohms ½ watt
R12 1,000 ohms ½ watt
R13 1 megohm ½ watt
R14 100,000 ohms ½ watt
R15 .5 megohms ½ watt
R16 1 megohm ½ watt
R17 50,000 ohms ½ watt
R18 .5 megohms ½ watt
R19 2,200 ohms ½ watt
R20 5 ohms ½ watt
R21 2,200 ohms ½ watt
R22 .5 megohms ½ watt
R23 .5 megohms vol. cont.
R24 50,000 ohms ½ watt
R25 .5 megohms tone control
R26 100,000 ohms ½ watt
R27 100,000 ohms ½ watt
R28 22,000 ohms ½ watt
R29 22,000 ohms ½ watt
R30 50,000 ohms ½ watt
R31 20,000 ohms ½ watt
R32 22,000 ohms ½ watt
R33 100 ohms 1 watt
R34 50,000 ohms ½ watt
R35 1 megohm ½ watt
R36 1 megohm ½ watt
R37 47 ohms ½ watt
R38 1,800 ohms 3 watt
R39 47,000 ohms ½ watt
R40 1 megohm ½ watt


SPECIALISTS IN A SPECIALIZED FIELD.
MR. SERVICEMAN.
Our Universal Coils, types 40 (Aer), 45 (R.F.) and 41 (Osc) will replace any damaged R.F. Coil.
Inductance Specialists
COILS, I.F. TRANSFORMERS, R.F. CHOKES, R.F.C.'s, DIALS, SCALES, COIL ASSEMBLIES, GANGS, BUILT-UP UNITS, ETC.

When there's a better switch
ARCOLECTRIC will make it
New Zealand Agents
GREEN & COOPER LTD. WELLINGTON.

RADIO SERVICING
Correspondence Course specially compiled to meet New Zealand Examination Syllabus. Free prospectus.
NEW ZEALAND RADIO COLLEGE
26 HELLABY'S BUILDING - - AUCKLAND C.1

BINDERS FOR "R. & E."
These are available to hold 12 issues—price 5s. 6d.

Russell Import Co. Ltd.

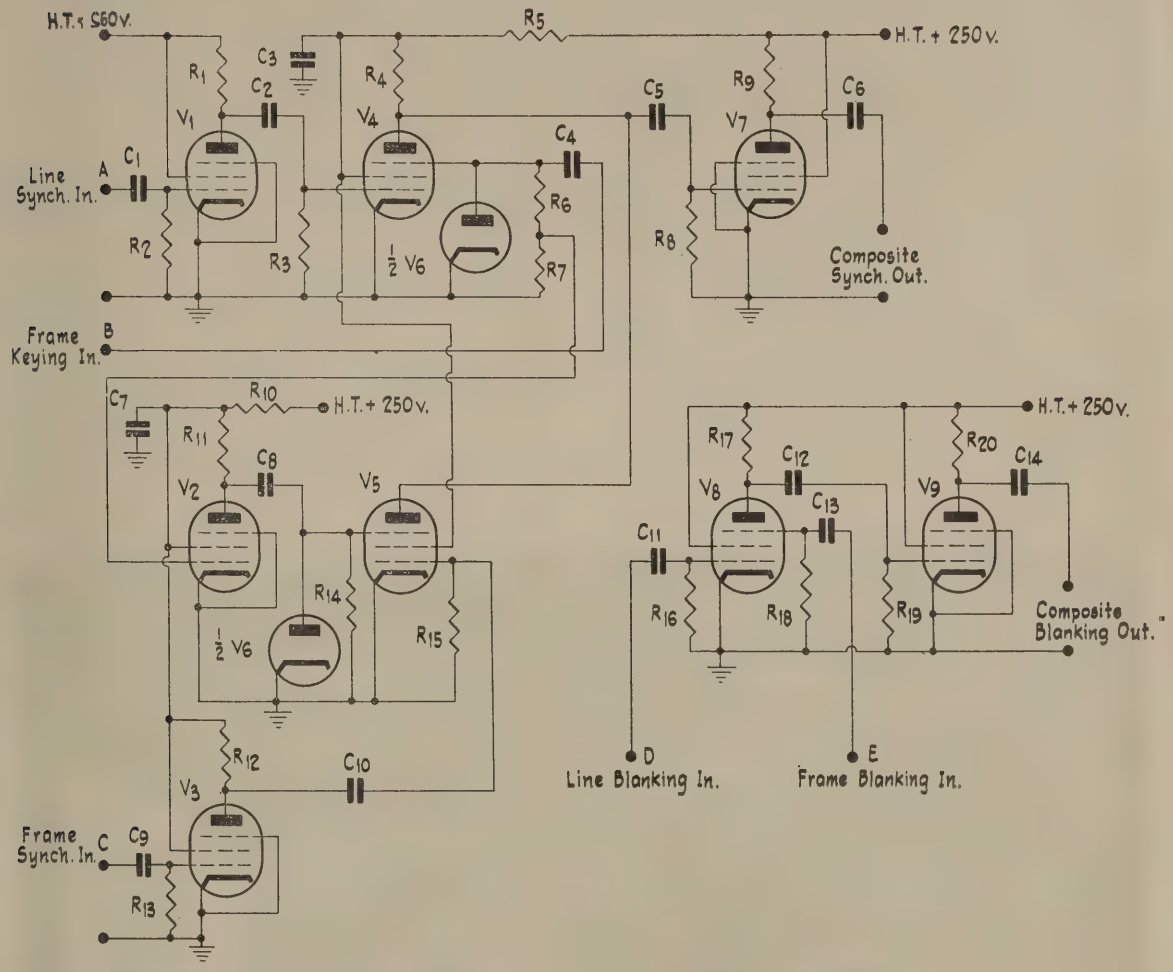
NEW ZEALAND DISTRIBUTORS OF

ACCORDIONS	*Hohner, Germany*
AERIALS	*Antiference, England*
BINOCULARS	*Wray, England*
CAMERAS	*Gnome, England*
CLAVIOLINES	*Selmer, England*
CLOCKS, ELECTRIC	*Sterling Croydon, England*
FIRES, ELECTRIC	*Berry, Under Licence*
FLOOR POLISHERS	*Electrix, England*
GRAMOPHONE NEEDLES	*Songster, Stead, England*
" "	*Imhof, England*
" "	*S. G. Brown, England*
" "	*St. James, England*
GRAMOPHONES, PORTABLE	*Gallotone, South Africa*
"	*Decca, England*
GRAMOPHONE SPRINGS	*Stead, England*
GRAMOPHONE RECORDS	*Golden Voice, England*
"	*Selcol, England*
HARMONICAS	*Hohner, Germany*
HEADPHONES	*S. G. Brown, England*
IRONS, AUTOMATIC	*Morphy-Richards, Under Licence*
IRONS, TRAVELLING	*Smoothie, England*
IRONS, SOLDERING	*Brownleco, England*
PIANOS	*Challen, England*
"	*Steck, England*
"	*Squires, England*
RADIOS	*Philco, N.Z., Under Licence Philco, U.S.A.*
RADIOGRAM UNITS	*Collaro, England*
RADIOGRAM EQUIPMENT	*Decca, England*
RECORD CHANGERS	*Collaro, England*
RECORDERS	*Wirek Elect., England*
SCREWDRIVERS	*Stead, England*
SEWING MACHINES	*Jones, England*
SHAVERS, ELECTRIC	*Dandy, Switzerland*
TEST EQUIPMENT	*Stark, Canada*
"	*Morphy-Richards, England*
TOASTERS, AUTOMATIC	*Morphy-Richards, England*
VACUUM CLEANERS	*Electrix, Under Licence*
LIGHTING PLANTS	*Universal, U.S.A.*
IRON STANDS	*Morphy-Richards, England*
VALVES, RADIO	*Philco, U.S.A.*

Trade Inquiries Welcomed. *Telephone* **43-436.** *Telegraph:* ***"Rimco," Wellington***

RUSSELL IMPORT CO. LTD., 18-20 BOND ST., WELLINGTON **P.O. Box 102.**

The "R. & E." Synch. Signal Generator—Part VIII



CIRCUITS FOR THE PULSE-MIXING STAGES

The block diagram of the pulse-mixing stages was printed in the last instalment of this series. The simplest part, with which we commence this description, is the mixer circuit which provides the composite blanking signal, after having been fed with the individual blanking waveforms at its two input terminals. The valve numbering and the lettering of the input terminals corresponds with that on the block diagram. The blanking mixer, V_8, is a pentode-connected EF91, in which the line blanking pulses, in negative polarity, are applied to the control grid, and the frame blanking pulses, also in negative polarity, are applied to the suppressor. What we want is that the frame blanking pulse should appear at the same point on the circuit as do the line blanking pulses, and that while the frame pulse is present, no line pulses should appear. This condition will be satisfied if the frame pulses are able to cut off the plate current of the mixing valve

C_1, C_2, C_9, C_{10}, C_{11}, 0.002 μf.
C_4, C_5, C_6, C_8, C_{12}, C_{13}, C_{14}, 0.25 μf.
C_3, C_7, 8 μf. 350v. electro.
R_1, R_9, R_{11}, R_{12}, R_{17}, R_{20}, 10k.
R_2, R_3, R_6, R_8, R_{13}, R_{14}, R_{15}, R_{16}, R_{18}, R_{19}, 2 meg.
R_4, 5k.
R_5, R_{10}, 15k.
R_7, 0.25 meg.
V_1, V_2, V_3, V_4, V_5, V_7, V_8, V_9, EF91 or Z77.
V_6, EB91 or 6AL5.

BINDERS FOR "R. & E."
These are available to hold 12 issues—price 5s. 6d.

completely. Since the valve cannot be made to pass less than zero plate current, any line pulses that appear on its grid during the length of the frame pulses will have no effect on the plate current, so that the frame pulse will be present without any line pulses appearing until it is over. When this happens, the suppressor is returned to its normal potential, so that the control grid takes over once more, and the line pulses appear. In the plate circuit of the mixing valve, the polarity of the pulses has been reversed, and is now positive. A later step in the process of building up the complete video signal is to mix the composite blanking signal with the video signal, and for this purpose we want to use the composite blanking on the suppressor grid of an otherwise normal video amplifier, in order to suppress the video signal for the duration of each blanking pulse. Consequently, the composite blanking must be of negative polarity, and so a further stage has been added, which merely amplifies the signal, and clips it, removing any slight imperfections resulting from the action of the blanking mixer. V_9 performs these functions, and the terminal labelled Composite Blanking Out, delivers a nicely squared-up version of the signal, but in negative polarity once more, suitable for inserting into the video mixer.

The remainder of the circuit has already been briefly described, in connection with the block diagram, but a slightly more detailed account would be advisable.

In order to produce the composite synch signal, we require the following kinds of pulses:

(1) Line synchronizing (negative polarity).
(2) Frame keying (negative polarity).
(3) Frame synchronizing (or frame serrating—they are the same).
(4) Frame keying (positive polarity).

Since the polarity requirements of the mixing stages do not correspond in all cases with the actual polarities of the pulses as they are produced by the pulse generators, it is necessary in some cases to have phase reversing valves between the input terminals and the appropriate electrodes of the mixers. These complicate the look of the circuit somewhat, but since their only function is as stated, they do not add to the difficulties associated with making the mixers function satisfactorily.

The first mixer is V_4, which mixes the line synch. pulses with the frame keying pulses in such a way as to remove the line pulses for the length of time taken by the keying pulses. In other words, the keying pulses key the line pulses out for a short time. This time is exactly equal to the duration of four lines, because the space thus created has, in the next stage, to be filled with eight of the frame serrating

What's inside this carton is world-famous!
"The finest cored solder in the world"—containing
THREE CORES OF NON-CORROSIVE ERSIN FLUX!
ERSIN
Multicore
THREE CORE SOLDER
CONTAINS 3 CORES OF NON-CORROSIVE FLUX
3 CORE SOLDER
NO EXTRA FLUX REQUIRED
New Zealand Distributors:
GILES & ELLIOTT LTD.
AUCKLAND — WELLINGTON — CHRISTCHURCH — DUNEDIN
also obtainable from all Branches of
TURNBULL & JONES LTD.

pulses. Now these occur at twice line frequency, so that in the time of exactly four lines, precisely eight serrating pulses can be put in.

The line pulses are fed in negative polarity to the grid of V_4 from the reversing valve V_1, so that V_4 conducts for the periods in between pulses, and is cut off to make the pulses appear in the plate circuit. The keying pulse, too, takes the valve to cut-off, and so the output of V_4 alone looks very similar to that of the blanking mixer.

The other mixer, V_5, accepts frame serrating pulses (or frame synch. pulses, whichever one prefers to call them) in positive polarity from the reversing stage V_3, and frame keying pulses in positive polarity from the reversing stage V_2. Thus in V_5, the serrating pulses appear only for the duration of the frame keying pulse. Since this is four lines long, eight of the serrating pulses appear in the space previously occupied by the four line pulses which the first mixer has removed.

The third and final mixing action takes place in the plate circuit of V_4 and V_5. It will be noted that these two mixers have a common plate load resistor, with the result that their respective output waveforms are added together. To see how this comes about, let us consider the separate mixing actions once again. The output of V_4 consists of positive-going line synchronizing pulses, with a four-line frame frequency pulse added, and replacing four of the line ones. The frame pulse is also positive-going, so that the valve is cut off, and its plate is at H.T. voltage during (1) the tips of the line synch. pulses and (2) during the frame keying pulse, the latter is perhaps best regarded as the actual frame synchronizing pulse, going in the same direction as the line pulses, but as yet without the serrations, or slots, which break it up into eight equal parts, and whose duty is to allow the line time-base to be kept in synchronism while the frame pulse is "on." Now in the plate circuit of V_5, the frame serrating pulses are in such polarity that the slots are negative-going. The selected eight, therefore, are allowed to occur by the keying pulse at the right time to cut eight slots in the broad frame synchronizing pulse. When this is done, we have the complete composite synchronizing signal which we set out to generate.

VIDEO? BLANKING? AND SYNCH. MIXERS

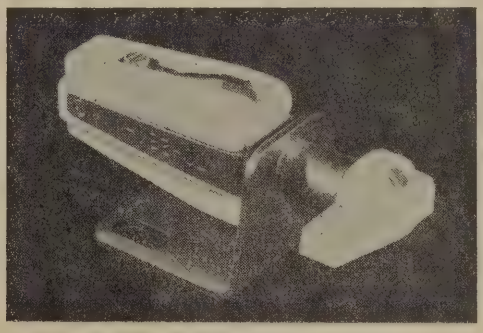
In the next and final instalment of this series, we will describe the two further mixing circuits which mix the video signal with the blanking pulses, and then clip the combined waveform to establish the black level, and which finally mix the blanked video signal with the sychronizing pulses. This final step gives the complete composite video signal.

"R. & E." TECHNICAL PHOTOGRAPHS

Copies of original designs produced in our laboratory and featured in these pages are available. Prices are: Size 6 in. x 4 in, 3s. 6d.; 8 x 6, 4s. 6d.; 10 x 8, 5s. 6d. Please remit cash with order to Radio and Electronics

RONETTE

TURNOVER CRYSTAL PICK-UP CARTRIDGE TYPE 284N



The ideal replacement cartridge. Designed to fit Garrard, Collaro, B.S.R., and other standard pick-up arms. Easily mounted, robust, high output; sapphires are easily replaced, being held by one screw.

Type 284P Turnover cartridge at same price but high fidelity. Constant velocity characteristic ±2 db. between 25 and 12,000 c.p.s.

Retail Price 284 N or P 42s. 6d. each.

Trade Inquiries invited

Green & Cooper Ltd.

RADIO ENGINEERS

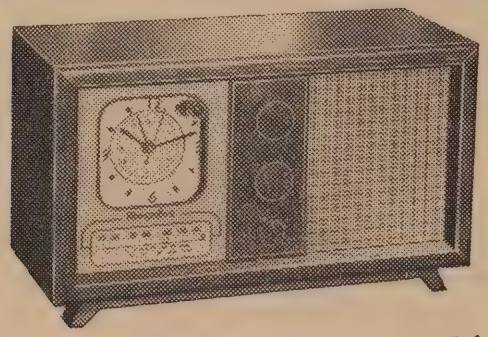
Phone 54-418 Telegrams: "FIDELATONE"

43 LOWER TARANAKI STREET, WELLINGTON, C.3

NEW PRODUCTS: LATEST RELEASES IN ELECTRICAL AND ELECTRONIC EQUIPMENT

This section of our paper is reserved for the introduction of new products and space preference is given to our regular advertisers. Advertising rates are charged according to space occupied. For further particulars contact Advertising Manager, R. and E., Box 8022, Wellington.

THE PACIFIC AND REGENT CLOCK-RADIOS



There has long been room in New Zealand for a really superlative clock-radio at a practical price. G. A. Wooller with their Regent and Pacific Models 4CR fulfil this need to perfection. The Regent and Pacific Clock-Radios combine a quality 4-valve radio (with one dual-purpose valve to give genuine 5-valve performance) with a most reliable electric alarm-type clock. All this at a retail price of only £25 10s.

With the Regent and Pacific 4CR the clock can be set to turn the radio on at any time. In the meantime the radio stays connected to the power supply but does not operate until required to. The Clock-Radio can, of course, be used as an ordinary radio and the clock can always be relied on for the correct time.

The advantages of the Regent and Pacific Clock-Radios, particularly at this highly competitive price, are legon. In its modern walnut veneer cabinet the Pacific and Regent 4CR is perfect for living-room, bedroom, or kitchen use. The tone quality of the 4CR is really superb because of the use of inverse feedback from the voice coil of the 6 in. x 4 in. oval loudspeaker, which flattens out cone resonances.

The Pacific and Regent Clock Radios are distributed throughout New Zealand by G. A. Wooller and Co. Ltd., P.O. Box 2167, Auckland.

* * *

"ULTIMATE" MINICHEF

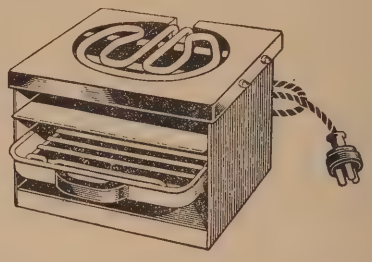
The Ultimate cooker illustrated here, is a versatile cooking appliance and may be used for frying, boiling, toasting, grilling, and stewing.

It has a novel element arrangement which enables the user to detach the tubular radiant element from the Minichef framework and use this as an immersion heater for saucepans or other large utensils.

The little kitchen appliance measures only 9¾ in. x 13½ in. x 7¼ in. high, utilizing the entire volume for concentrated cooking.

Grilled meals can be prepared with a minimum of power consumption as the element can be used for stewing vegetables at the same time as meats are being grilled.

The Minichef is robust and easily kept clean. It is finished with nickel top and pastel body surround.



The Minichef has a newly developed inconel or radiant type element, economical in use and most efficient as regards heating up and distributing of heat. The element, as previously stated, may be used as an immersion heater and is instantaneously detachable.

The accessories included with the Minichef are a pressed steel tray, a wire drainer or grill and a heat reflector.

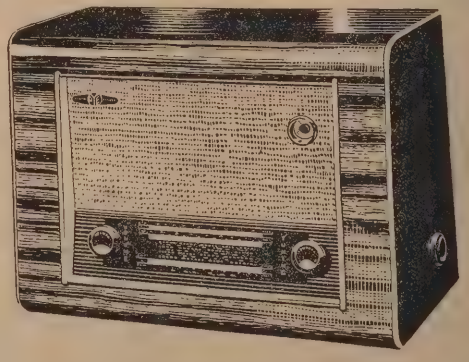
The Minichef is easily the most versatile cooking appliance on the market today and is priced at only £3 19s. 6d. retail.

Specification: Size 13½ in. x 9¾ in. x 7¼ in. high. Rating, 1350 watts. Immediately available.

* * *

THE NEW PYE "71"

Pye again take the lead in bandspreading. The New Model "71" recently released throughout New Zealand, features 5-band bandspreading on a 5-valve receiver of outstanding quality for only £29 15s. This is the first time in New Zealand that a band-



spread radio has been offered way down in the "popular" price range.

The Pye "71", shown above, is the perfect radio for any home, any room. It is delightfully styled in rich mahogany with contrasting grille and dial colours; so the "71" will blend to perfection with any furnishing scheme.

Some of the other features that make the Pye "71" a certain best-seller are: a magic-eye for easier tuning; a 6 in. P.M. moving-coil loudspeaker (with sockets provided for an extension speaker of 2 to 4 ohms impedance); complete tropic-proofing of all components and metal work.

The waveband coverage of the "71" is as follows: Broadcast, 550–1600 kc/sec.; medium shortwave, 1.6–4.5 mc/sec; 31 metres, 9.2–10.2 mc/sec. bandspread; 25 metres, 11.2–12.6 mc/sec. bandspread; 19 metres, 14.6–16.2 mc/sec. bandspread. Cabinet dimensions are: 16½ in. long; 12½ in. high; 7½ in. front to back.

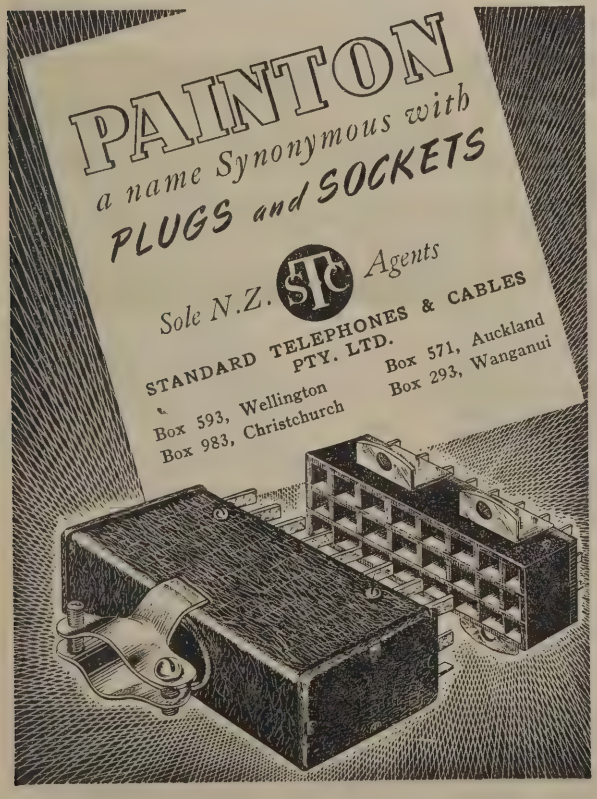
Model "71" is a worthy addition to the Pye range of quality radios distributed throughout New Zealand by Pye (New Zealand) Ltd., Box 2839, Auckland.

NOW—A BETTER, FASTER, MORE COMPLETE SERVICE TO THE RADIO AND ELECTRICAL DEALER

RADIO PARTS, VALVES, TRANSFORMERS, SPEAKERS, RECORD-PLAYING EQUIPMENT, ELECTRICAL APPLIANCES, and FITTINGS, Etc.

LEADING MANUFACTURERS REPRESENTED—CHECK WITH US FIRST—PROMPT DELIVERY TO ANY TOWN OR CITY IN NEW ZEALAND

S. C. DAVISON LTD.
WHOLESALERS & IMPORTERS,
P.O. Box 279 — Palmerston North — 323A Main St.



Loudspeaker Enclosures

(Continued from Page 11.)

in twenty or thirty is really satisfactory in this respect. You may be lucky to hear more than one or two in the course of a day's listening. A good test however is to listen to "live" organ broadcasts, one can then get a good idea of the effective response of one's enclosure.

In the final part of this series I will have something to say regarding records and record reproduction.

Wellington Radio Traders' Association

At the annual meeting of the Wellington Radio Traders' Association held in Wellington recently, the following officers were elected:—

President: Mr. N. J. Hallett.

Executive: Messrs. W. L. Young, R. B. Fowler, D. B. Billing, W. E. Brown.

Secretary-Treasurer: Mr. C. I. W. Archibald.
Auditors: Gordon, Berry & Tait.

Delegate to Executive of New Zealand Radio Traders' Federation: Mr. N. J. Hallett.

Delegates to any General Meeting of New Zealand Radio Traders' Federation: Messrs. N. J. Hallett and W. L. Young.

Mr. W. L. Young, the retiring President, was suitably thanked for his outstanding services during the past three years, members expressing regret at his decision not to accept office for yet another term.

PRESENTATION TO N.Z. EMPLOYERS' FEDERATION

On behalf of the New Zealand Radio Traders' Federation, the President, Mr. N. Souper, took this opportunity to present an electric clock to the New Zealand Employers' Federation, as a mark of appreciation of their 25 years' association. As a result of this liaison, the radio trade had benefited considerably, said Mr. Souper, who also referred eulogistically to the work of Mr. Camp, to whom most of the credit must go for the establishment of the original Trade Examinations.

SUBSCRIPTIONS

In view of the fact that the Association has extended its scope to include household electrical appliances, that the affiliation fee to the New Zealand Radio Traders' Federation has been increased, and that, as an additional service, each member now receives the *Bulletin* regularly, it was resolved that, for the ensuing year, the following subscription rates should apply: Wholesalers, £6 6s.; retailers, £3 3s.

NAME OF ASSOCIATION

On the recommendation of the Executive of the New Zealand Radio Traders' Federation, it was decided that there should be no change in the name of the Association, even though the scope of its activities had been enlarged by the inclusion of household electrical appliances. However, it was decided that an endorsement to the latter effect should be included on the letterhead.

FERRANTI —

PIONEERS IN THE ELECTRICAL FIELD FOR OVER 70 YEARS

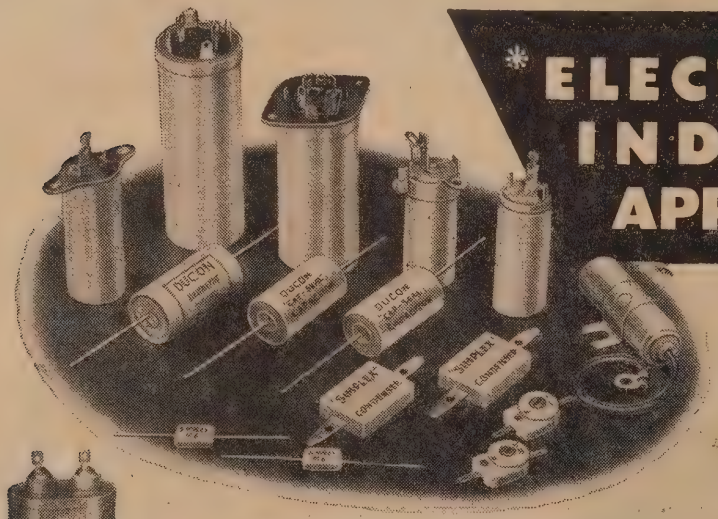
TRANSFORMERS ● VOLTAGE REGULATORS ● P.F. CORRECTION CAPACITORS ● INSULATION ● A.C. & D.C. HOUSE SERVICE SWITCHBOARD METERS ● A.C. & D.C. PREPAYMENT METERS ● VALVES AND CATHODE RAY TUBES ● METER TESTING EQUIPMENT ● ELECTRONIC DEVICES ● MEASURING INSTRUMENTS ● CASTINGS ● ELECTRIC CLOCKS ● ELECTRIC WATER HEATERS ● ELECTRIC FIRES AND SPACE HEATERS.

Sole New Zealand Agents:

ARTHUR D. RILEY & CO. LTD.

124 Hobson Street,
AUCKLAND

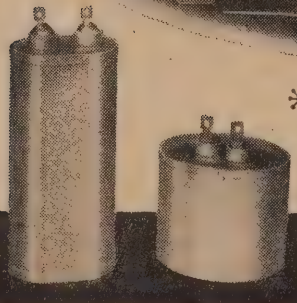
66–68 The Terrace,
WELLINGTON



FOR
* ELECTRONIC & INDUSTRIAL APPLICATIONS

Designed and built for dependable operation, Ducon Capacitors will stand up to most severe applications.

Ducon's 20 years of experience in this field can provide the answer to your Capacitor problems.



* *For all Capacitors for Electronic and Industrial application, specify DUCON*

DUCON *Capacitors*

DUCON (N.Z.) LTD., WELLINGTON

Works: 25-35 Haining Street. Tel 54 844
Office: 21 Grey Street. Tel 42-411
P.O. Box 630

New Zealand Radio and Television Manufacturers' Federation

WELLINGTON ASSOCIATION

In presenting the Annual Report of the Wellington Radio and Television Manufacturers' Association to the Annual General Meeting held recently in that centre, the President, Mr. R. Slade, commented briefly on the important matters dealt with during the past year.

These included the

Formation of a North Island Industrial Union of Employers of the industry, which subsequently led to the inauguration of a Radio Apprenticeship Committee. These two items marked the emergence of a fully fledged radio industry quite distinct from the electrical hen which hatched it.

From the Patent Activities, new patent laws for New Zealand will shortly emerge, and here the radio industry has played a prominent part in pressing for corrective action.

With regard to Import Matters out of which has developed a closer and more workable liaison with Government controlling bodies, it is only to be regretted that the word "control" still applies to departments whose function should be "advisory" and not "controlling."

The increasing seriousness of Radio Interference Problems has caused the rejuvenation of the Interference Advisory Board.

The limitation at present imposed on Broadcasting Hours is long overdue for removal.

The consequences of the many Sales Tax Anomalies necessitate an alteration in the Act.

With regard to the Training of Apprentices there is need for better training facilities in technical schools.

Confidential file of statistics for the radio industry.

The potentialities of the radio industry as a factor in National Defence.

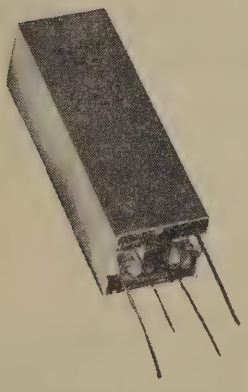
In spite of repeated representations, the Government continues to withhold vital information concerning television from the radio industry. All over the country, said Mr. Slade, and particularly within the radio manufacturing industry, preliminary activities—some of them of considerable magnitude—are taking place. In view of the Government's inexplicable reluctance to disclose vital technical information to the one body which can make television a service to the community, he continued, it could quite easily happen that much of the present activity may be involving the industry in partially wasted effort and quite unnecessary expense. Over 12 months ago the badly needed information was promised. Surely it is a serious responsibility of the Government, contended Mr. Slade, to put an end to this ridiculous and frustrating delay, and to disclose to the industry immediately, the information on which it can really initiate plans for the future.

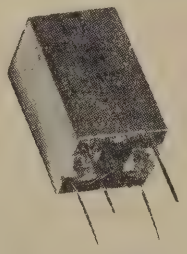
(Concluded on Page 48.)

MIGHTY - MIDGETS!

FERRO-MAGNETIC ENCLOSED — Inductances HIGH FREQUENCY — SHIELDED MINIATURE COILS

(Superior in performance to most full-size coils)





Size: Coils 13/16 in. sq. x 1⅜ in.

I.F. Trans. 13/16 in. sq. x 2⅜ in.

Aerial (Standard H.I.P.) Type 190A.

Aerial (Auto. Tapped) Type 200A.

R.F. (H.I.P.) Type 115A.

Osc. (ECH35 - ECH21) Plate Tuned. Type 111AU.

Osc. (6BE6 Tapped). Type 111AV.

(Full data supplied on request)

Coils as used in *Radio and Electronics* 5-Valve Receiver, August issue

See them at our Stockists or write for Full Particulars

INDUCTANCE SPECIALISTS LTD.

The Coil People

157 THORNDON QUAY - - - - WELLINGTON

Proceedings of the New Zealand Electronics Institute Incorporated.

At a meeting of the Dominion Council of the New Zealand Electronics Institute, Inc., held in Dunedin on 13th August, the following new members were admitted:

J. D. McKewen, of Dunedin (Associate Member).

H. G. Hedge and R. S. J. Pottinger, of Dunedin (Graduates).

M. M. Gillick, I. F. Hall, A. J. Trinder, all of Dunedin (Associates); J. W. Wrigley, of Wellington (Associate).

The following transfers were also effected:

W. S. Shiel, of Dunedin, from Associate Member to Member.

G. Applegarth, of Dunedin, from Associate to Associate Member.

R. F. Harrison, of Auckland, from Student to Graduate.

The reconsideration of the membership qualifications required at each grade in the Institute and of suitable examinations and syllabii was discussed, and a committee consisting of Messrs. W. L. Shiel and W. G. Collett of Dunedin, together with a representative each from Wellington and Christchurch, was appointed to examine the matter further.

INVERCARGILL BRANCH

In view of the general interest in the New Zealand Electronics Institute evidenced in Invercargill, the Dominion President and Treasurer and the Dunedin Branch Chairman recently visited that city to meet and address those interested in the formation of an Invercargill Branch of the Institute.

Speaking of the purposes of the Institute, Mr. Symmons, the Dominion President, stressed the importance of providing a common meeting ground for all who are genuinely interested in the science and art of electronics, whatever their status, professional or hobbyist. No one doubts the benefit derived by the amateur through such an association with the professional, but the latter also gains stimulus and often inspiration from the amateur. Of equal importance is the fact that membership of the Institute clearly shows the professional standing of the member, especially in the two corporate grades,

(Continued on Page 48.)

"WILLIAMSON"
OUTPUT TRANSFORMERS

Wound to Mr. Williamson's EXACT Specifications

- 18 Windings in 2 Pi with 5 primaries and 4 secondaries on each.
- Primary inductance 115 henrys.
- Leakage inductance 20 millihenrys.
- Overall dimensions:—
  Height, 6½ in.; Breadth, 4½ in.; Depth, 4¾ in.

POWER TRANSFORMERS, CHOKES, Etc., WOUND TO ORDER

WISEMAN ELECTRIC COMPANY LTD.

35 VIVIAN STREET, WELLINGTON | P.O. BOX 2020, WELLINGTON | TELEPHONE 55-272

TRADE WINDS

JIM GASSON BACK IN RADIO

We hear that Jim Gasson is back in the Wellington-Hawke's Bay territory, now representing Martin Burns & Co. Ltd., distributors for G. A. Wooller & Co. Ltd., Auckland.

Jim Gasson, who was with Philips for nearly four years, is well known to dealers throughout Wellington and Hawke's Bay. For the past 18 months he has been Wellington representative for Messrs. F. E. Jackson Ltd., Auckland, hardware wholesalers, and is now looking forward to renewing his contacts with the radio trade.

* * *

PHILIPS CINEMA TELEVISION INTRODUCED IN FRANCE

May 27th, 1953, will long be remembered by the whole of Paris cinema world, for on this date Philips, with their "Mammoth" TV projection equipment, brought a variety programme, broadcast by Radiodiffusion-Television Francaise, via the Eiffel-tower transmitter, to the 3 × 4 metres screen of the cinema "Marbeuf."

So successful was this trial, that on 2nd June, the "Mammoth" equipment was once again used in the same theatre, this time to project the Coronation of Queen Elizabeth, beamed to the Continent from London and relayed by the Paris transmitter. Under the patronage of the French Minister of Information and the Ambassador of Great Britain in Paris, this screening was attended by many French authorities, all of whom were most impressed by the excellent picture quality obtained.

* * *

INDUSTRIAL TELEVISION

Television as a technological tool is envisaged by many leading industrialists. For activities where the handling is too dangerous, too inaccessible, too far, too hot, too high, too dark, too tiring, to inconvenient, too scattered, or too expensive to observe directly, then television may help solve the problem.

* * *

H.M.V. ROYAL RECORD

Coincidental with this coronation year, H.M.V. have produced a new long-playing record (ALP1043), telling the story of Her Majesty Queen Elizabeth II. "Through Childhood to the Throne" as it is entitled, plays for approximately 50 minutes and was recently broadcast on the B.B.C. Later, an abridged version on three 12 in. H.M.V. 78 r.p.m. records (DB9794-5-6) will be issued.

* * *

IS SOUND BROADCASTING A BACK NUMBER?

In countries where television is now well-established, many people hold that the day of "sound" broadcasting is over. It's only a matter of time, they say, until all broadcasting is of the sound-and-vision kind. A writer in a well-known overseas journal, however, contends that much reception, if not indeed the bulk of it, will continue to be of the "sound only" type. In his opinion, the things one wants to see by radio are not very many. Big national, civic and sporting events—yes. Plays, ballet and so on—occasionally. Orchestras and instrumentalists—not after a short preliminary glance just to find out what they look like. Singers—definitely NO. Debates and discussions—again NO, after the first few moments. Once you know what each of the participants looks like, it is pleasanter to follow the argument by listening instead of having one's attention distracted by constant switches to close-ups—which are not always too prepossessing!

* * *

ALUMINIUM CONDUCTORS

Writing in the March number of the *South African Electrical Review,* Mr. F. McDonald contends that the time will come when the use of aluminium instead of copper for the carrying of electric power will be the general rule. He considers that this will be brought about not only on account of the impending shortage of copper, but also because aluminium possesses, in its own right, very distinct advantages, such as lightness, strength, economy, and versatility.

* * *

TRANSFORMER CO. OF N.Z. LTD.

Although one of the newer arrivals in the transformer manufacturing field, the Transformer Co. of N.Z. Ltd., in its Petone factory, is well organized to handle anything from special audio transformers to large 3-phase power transformers. During a recent visit to collect some lusty power transformers generously donated by the Transformer Co. to the Wellington Branch of the Electronics Institute for its TV transmitter, we found a surprisingly wide range of special jobs in progress. From the orders he has received for special transformer and rectifying equipment, Mr. Howard Weenink, Managing Director, thinks the radio and electrical business must be enjoying a boom!

TYPE "B"

Plessey POTENTIOMETERS

A full range of Wire-wound Controls by Plessey is in stock in values from 10 ohms to 25,000 ohms.

SWAN ELECTRIC CO. LTD.

Auckland Wellington Christchurch

patient's internal organs now obscure to him. Increased brightness will make possible a movie-like viewing of all internal organs and movements from any angle.

* * *

EMITRON FILM CHANNELS FOR ITALY

British equipment to the fore again—the R.A.I., Radio Italiana of Turin, Italy, have ordered two flying spot film channels from Emitron Television Ltd. These equipments will operate on 625 lines, 25/50 frames interlaced, and are to be used at the new Italian television station at Turin. Facilities for both 35 mm. and 16 mm. film lantern-slide operation will be provided.

* * *

STARTLING EFFECTS FROM NEW TV DEVICE

Soon British televiewers will see startling effects on their TV screens when a hush-hush gadget costing nearly £10,000 is used. Dramatic shocks are in store for viewers, and a considerable saving in scenery for producers, for this new equipment will enable them to produce "punch" holes in a TV picture and place a second picture in the holes thus made. Until now, "ghost" effects and other camera tricks have been done by the superimposition of one camera on another.

Developed by the B.B.C.'s own engineers, this new process, called "Inlay," will enable actors to appear to speak from aircraft, buses, etc., simply by standing alone in a TV studio. Postcard size photographs of backgrounds or "props" will be fed into the new machine. So also will be "live" pictures of the performers. A touch of the switch, and viewers will gasp at the effects produced on their screens.

Ah yes, it will also mean back to a TV school again for scores of producers before they can use the new gadget!

* * *

V.H.F. COMMUNICATION IN TOWING OPERATIONS

Following previous experience of the use of very high frequency radio-telephone communication during the handling of large vessels after launching one or two, Vickers-Armstrongs, Ltd., again employed this system recently when moving the light fleet aircraft carrier H.M.S. *Hermes,* from Buccleuch Dock to Ramsden Dock.

The operation was carried out with the assistance of three tugs, all of which were permanently equipped with Marconi Marine "Seaphone" V.H.F. transmitter/receivers. A similar set temporarily installed on board H.M.S. *Hermes* for the occasion provided full speech communication between the carrier and all tugs employed.

Similar arrangements were made during the launching of H.M.S. *Hermes* earlier this year and during the towing of H.M.S. *Majestic* from Barrow-in-Furness to Birkenhead last year.

Tugs equipped with "Seaphone" V.H.F. sets also attended the launching of the new 28,000-ton Orient liner *Orsova,* one of the largest vessels launched this year.

* * *

RADAR PLOTTER

Observation of a radar screen is not in itself sufficient to prevent a collision between ships. It is essential to keep a good radar plot, and hitherto it has been necessary to do this on a chart or plotting sheet. Now, however, Decca have produced a screen which enables direct plotting on the radar display without the serious parallax error caused by the normal screen being some distance from the actual tube face.

A half silvered mirror is placed between the tube and the perspex plotting surface. The curvature of this surface is opposite to that of the P.P.I. so that the reflection of any mark made on the plotter will coincide with the radar echo on the tube when viewed from any angle. The plotting screen is edge-illuminated so that wax pencil marks show up clearly on the radar screen, but when the light is switched off, the marks are not visible on the P.P.I. The "Deccaplot", as it is called, fits over the face of the standard Decca 12 in. display unit. A picture of this equipment appeared on the front cover of our June issue.

DISC RECORDING EQUIPMENT

Here is a real bargain in the way of equipment for direct acetate recording at 33 1/3, 45, and 78 r.p.m.

RECORDER DECK, Byer, Model R-12-D
3-speed, as above, at standard or microgroove pitches. Cuts inside-out or outside-in.

CUTTER HEADS, Byer
2 Standard Heads and 2 Microgroove Heads (one damaged). All heads high-impedance (400 ohms at 1000 c/sec.

MICROPHONE AND ACCESSORIES, Philips
Moving-coil Philips Microphone, with floor stand and 80 feet of Philips microphone cable.

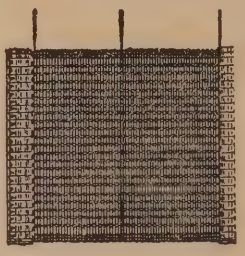
Equipment mounted in grey crackle steel cabinet, 17 in. x 17 in. x 6in., with lid and carrying handles.

This is professional equipment which has seen approximately four hours' actual recording time, and is in excellent condition.

PRICE: Recorder and Heads, £75; Microphone and etceteras, £15.

"RECORDER,"
C/o "RADIO AND ELECTRONICS"

CRESSALL
ASBESTOS - WIRE - WOVEN RESISTANCE NETS



Cost So Little and Help So Much

Stocks available from

Bradley's Electrical Co. Ltd.

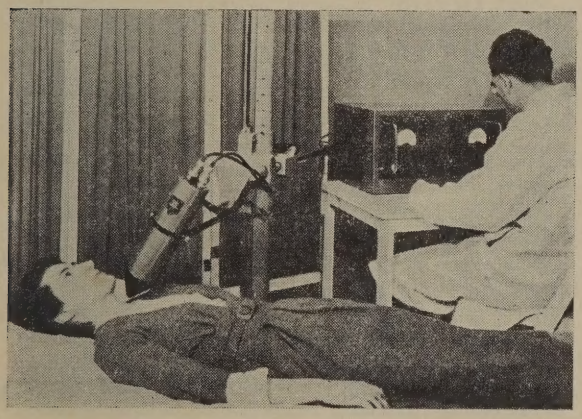
57 Victoria Street, Wellington
and at
62A Cook Street, Auckland
New Zealand Distributors for
The Cressall Manufacturing Co., Ltd.,
Birmingham, England.

Instruments that Aid Science and Industry

By Joseph Earl, English Technical Journalist

It is not uncommon today, to find that scientists are measuring in millionths of an inch. If the imagination boggles at that kind of accuracy, how much more difficult will it be to appreciate the accuracy of the gauges which must be used to check the instruments making measurements in millionths?

Perhaps it will be more profitable to try to find out what uses scientists are making of such minute measurements. The opportunity was provided at the British Instrument Industries Exhibition, held in London. There, nearly 200 United Kingdom firms showed products ranging from the latest types of balances—looking curiously



A medical scintillation counter being used in a United Kingdom hospital in conjunction with a scaler. Patients are injected with radioactive sodium and the scintillation counter converts the radiations given off into flashes which are easy to count.

old-fashioned among all the chromium-plated glitter—to new instruments for work on atomic energy and radioactive isotopes. Several instruments used isotopes for their work. One of these was a wind-measuring instrument which showed the speed of air movement caused by the wave of the hand. Another counted the radiations given off by active materials. This is called a scintillation counter because it turns the radiations into flashes to simplify the counting.

THE RIGHT SHAPE

Most people, however, are much more interested in the practical value of things than in scientific theories, and there were plenty of examples of that kind of instrument on show. For instance, one of the problems of the engineers who make jet engines for aircraft and other uses is to make the blades of the jet turbines of exactly the right shape to get the best results. The most difficult parts of the blade to make accurately are the edges. Now a United Kingdom firm has come forward with an instrument which enables anyone with normal eyesight to see exactly how right—or wrong—the blade shape is compared to a perfect pattern. Another instrument, made by the same firm, enables engineers to be certain, when setting up big machines, that they are truly flat.

With three-dimensional films so much in the news, it was to be expected that science would find a use for them. On one stand at the exhiibtion was what was claimed to be the world's first slow-motion, three-dimensional film. It showed the interior of a blast furnace in ful operation, and its purpose was to improve the burning of the coke so that no heat and no coke were wasted. Nearby was an amusing apparatus which could be described as an "electronic nose." The main function of this device is to "smell" out water, or, more scientifically, to detect the movement of water in solid materials. So sensitive is it to vapours that it responds to quite a number of smells. It registered violent activity when a puff of cigarette smoke was blown at it.

At the other extreme was an instrument for investigating the behaviour of the wind. This device measures gusts of wind, and one of the gusts it has measured was the biggest ever known in Britain, one of 125 miles (200 kilometres) an hour, which occurred not long ago in the Hebrides, off the coast of Scotland.

GLASS BRICKS

The shielding of those who work with radio-active materials is vitally important for their health. But the problem is to see what is happening on the other side of the most commonly used form of shielding, lead bricks. To overcome this difficulty, one firm has produced bricks of special glass which contains a large

proportion of lead oxide. These give a very high degree of protection, and yet enable the operator to see what he is doing.

The television tube has come to the aid of the scientist in another field, particularly in making easier the teaching of science. This is what is called a "flying spot microscope." In fact, the whole thing is a television camera adapted to "view" the scene in the microscope and project it on to a screen so that a whole class of students can see the specimen at the same time—and with a magnification of up to 8,000 times.

This says nothing of all the hundreds of instruments of more or less conventional types without which scientists could not work, and which were on show. But the United Kingdom scientific instrument maker has a high reputation throughout the world, and his products are available to all through the trade associations dealing with them.

Manufacturers whose products are mentioned in the above article are as follows:

Balances: W. and J. Becker, Ltd., Nivoc House, Ealing Road, Alperton, Middlesex, England.

Anemometer and scintillation counter: Isotope Developments, Ltd., 120 Moorgate, London, E.C.2.

Turbine blade-edge microscope and sweep optical square: Taylor, Taylor, and Hobson, Stoughton Street, Leicester, England.

High speed stereoscopic photography: British Iron and Steel Research Association, 11 Park Lane, London, W.1.

Lead glass bricks: Chance Bros., 28 St. James's Square, London, S.W.1.

Flying spot microscope: Cinema-Television, Ltd., Worsley Bridge Road, London, S.E.26.

PUBLICATIONS RECEIVED

Westinghouse Engineer, Vol. 13, No. 4, July , 1953.

Electronic Engineering, Vol. XXV, No. 305, July, 1953.

Service, Vol. 22, No. 6, June, 1953.

Electronic Measuring, Vol. 3, No. 10. Philips Electrical Industries of New Zealand, Ltd., Wellington.

Jenolite News, Vol. 5, Nos. 4 and 5, April and May, 1953. Jenolite Ltd., London. (N. A. Parton Ltd., Wellington.)

Philips Electronic Application Bulletin, Vol. 13, No. 10, October, 1952. N. V. Philips' Gloeilampenfabrieken, Eindhoven, The Netherlands. (Philips Electrical Industries of New Zealand Ltd., Wellington.)

Osram Bulletin, Vol. 30, No. 2, April, 1953. General Electric Co., Ltd., England. (British General Electric Co. Ltd., Wellington.)

G.E.C. Progress Sheet, April, 1953. General Electric Co. Ltd., England. (British General Electric Co. Ltd., Wellington.)

N.Z. Science Review, Vol. 11, Nos. 6-7, and 8.

Wireless World, Vol. LIX, No. 7, July, 1953.

Elektrotehniski Vestnik (Electrotechnical Review, Organ of Electrical Engineers of Yugoslavia, 1953, 5-6).

Philips Lines and TV Pictures—N. V. Philips' Gloeilampenfabrieken, Eindhoven. (Philips Electrical Industries of New Zealand Ltd., Wellington.)

New Zealand Electrical Journal, Vol. 26, No. 8—August, 1953.

Philips Technical Review, Vol. 14, Nos. 1, 2, 3-4, and 5, July, August, September-October, November, 1952. N. V. Philips' Gloeilampenfabrieken, Eindhoven, The Netherlands. (Philips Electrical Industries of New Zealand Ltd., Wellington.)

La Radio-Revue, Vol. 5, Nos. 7-8, July-August, 1953.

G.E.C. Telecommunications, No. 16, April, 1953. General Electric Co., Ltd., England. (British General Electric Co., Ltd., New Zealand.)

U.S.A. Today, Vol. V, No. 17, August 31, 1953.—United States Information Service, Wellington.

Must Tubes Be Selected?—Amalgamated Wireless Valve Co. Pty., Ltd., Sydney.

das elektron, Juni/Juli-Ausgabe.

Wireless and Electrical Trader, Vol. 91, No. 1189, July 4, 1953.

Wireless Engineer, Vol. 30/7, July, 1953.

The New Zealand Manufacturer, Vol. 5, No. 2, August, 1953.

A.P.A.E. Journal, Vol. 4, Nos. 6 and 7, June and July, 1953.

Radiotronics, Vol. 18, No. 8, August, 1953. Amalgamated Wireless Valve Co. Pty. Ltd., Sydney.

BINDERS FOR "R. & E."

These are available to hold 12 issues—price 5s. 6d.

"STUDENT ENGINEER 1953"

CANTERBURY UNIVERSITY COLLEGE, NEW ZEALAND

The annual publication of the Engineering Society, Canterbury College, is now available. "Student Engineer" contains articles and addresses to the Society meetings by guest engineers and by students competing for the Templin Scroll. A wide range of engineering subjects is covered, including one on colour T.V.

Price: Three Shillings, post free
Limited stocks of previous years available.

Inquire among your staff and your friends, and send your orders to—

The Business Manager,
"STUDENT ENGINEER 1953,"
Canterbury College,
CHRISTCHURCH, C.1.

Please forward me copies of "Student Engineer 1953," for which I enclose postal note/money order.

Name .....

Address .....

.....

.....

CLASSIFIED ADVERTISEMENTS

ENGLISHMAN recently arrived in New Zealand seeks employment in radio or allied trade. London experience radio and TV installation and service, also electro-mechanical devices. Married accommodation necessary. References and further particulars from Mr. L. Birch, Awakino Road, Dargaville.

FOR SALE
TAPE RECORDER

We have for sale a fully professional tape-recorder using BRADMATIC desk modified for higher speed operation. Recording and play-back equalization based on MAGNECORD practice. Constant impedance configuration record equalizer switched for dual-speed operation. All specifications—e.g., WOW, distortion, etc., within N.A.B. standards. Full monitoring facilities, DB. meter, and instantaneous play-back whilst recording. Supplied with ribbon microphone (500-ohm balanced line), two spare heads, six spools SCOTCH tape, patching plugs, etc.

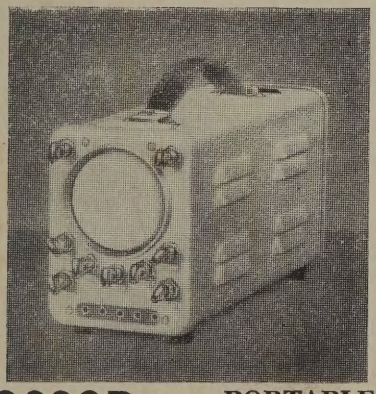
Price £170

This Recorder has had approximately 300 hours' operation as the master medium for musical programme work which is transferred to disc.

Here is a rare opportunity for a private recording company to acquire a high-grade recorder at a reasonable price.

Principals only may have further details and demonstration on application to—

The Manager,
P.O. Box 194,
DANNEVIRKE



COSSOR PORTABLE OSCILLOGRAPH

Although miniaturized and weighing only 9½ lb., the Cossor Oscillograph is fitted with a tube of 2¾ in. diameter, providing a screen of adequate size for monitoring and service displays. The Cossor is a truly portable instrument, 5½ in. high, 4½ in. wide, and 11½ in. long.

AVAILABLE EX STOCK. PRICE £47 8s.

Full details on request to:

SWAN ELECTRIC CO. LTD.

Auckland Wellington Christchurch

TELEVISION NEWS

(Through Courtesy of Dominion Radio and Electrical Corp.)

ENGLAND AND THE CONTINENT

The B.B.C.'s booster station for Brighton, Shoreham and Worthing was opened in June. Costing £10,000, the equipment is situated on the 700 ft. Truleigh Hill, sixty miles from Alexandria Palace. The radius of satisfactory reception from Truleigh is twenty-five miles . . . a television camera which will take three-dimensional pictures 1,000 ft. under the sea has been designed and tested by the Admiralty . . . Sir Ian Jacob, Director General of the B.B.C. recently stated that 97 per cent. of Great Britain's population would be served by television within five years. A total of eighteen stations are planned for . . . a National Council, with Lord Waverly as President, has been formed to resist the development of commercial TV . . . international television broadcasts between England and Europe have proven to be an outstanding success. While sound broadcasting is complicated by language difficulties, a television programme can have universal appeal . . . six mobile camera units and twenty cameras were used to televise the Coronation. Rated the world's best programme to date, it was a new triumph for television. The broadcast commenced at Buckingham Palace at 10.15 a.m. and continued until the Queen returned to take the R.A.F. salute at 5 p.m. Relayed to the Continent by the "Eurovision" network, an estimated 25,000,000 viewers followed the entire proceedings. Large size television screenings were shown in many picture theatres. The Festival Hall was booked out for an all-day TV show followed by a tele-film, re-showing the day's main events. The admittance fee of 25s. included a picnic lunch packed in souvenir carton . . . severe criticism has been levelled against American interests for the methods adopted in sponsoring some Coronation programmes; the main films for these were supplied free of charge by the B.B.C. under certain conditions which were not in all cases adhered to. Press and Parliament have taken up the controversy which has changed many opinions regarding a commercial service in Britain . . . while millions thrilled to television's crowning triumph on Coronation Day, a small frail woman sat watching the screen with even deeper feelings—personal feelings. It was her husband Britain's least honoured, almost forgotten genius John Logie Baird who made possible one of the wonders of the century. To our shame John Baird died, after years of broken health, at Bexhill on June 14th, 1946, at the age of 58. He received small recognition and less financial reward for his great contribution to science.

AMERICA AND CANADA

More than one hundred new television stations will be commencing operation in America this year . . . the Government has reserved for non-commercial educational use, 242 of the 1,500 new frequencies to be allocated . . . theatre and publishing magnates are becoming increasingly active in the ownership of television interests . . . Courtnay Pitt, Philco Vice-President, considers the proposed cost of colour TV to be excessive. Under present conditions, sets in the initial stages would cost twice as much as black and white receivers and programe production costs would be considerably higher. Compatible colour transmission (these could be received in black and white by existing sets) will be available late 1955 . . . Canada's three operating stations cover 40 per cent. of the country's population. Three further national transmitters are planned and after their erection privately owned stations will be permitted in those areas not covered by Government transmitters.

N.Z.R.T.M.F.

(Continued from Page 41.)

MONOPOLY INDUSTRIES

It was considered that the Association and the Federation should press that local manufacturers enjoying monopoly protection should ensure that their products incorporated the results of the latest overseas research both in design and quality. Moreover, members should be alert to notice overseas developments and keep the Association informed if the local manufacturers did not, within a reasonable period, incorporate some of these improvements.

MEETINGS

In order to overcome the problem of inadequate attendance at meetings, the retiring President, in presenting his annual report, suggested that semi-social functions such as the visit to Titahi Bay, might prove more attractive to members than formal business meetings. It was decided that such arrangements should be left in the hands of the Executive, with the possibility of a visit to the P. & T. Station at Makara and the 2YA studios.

Proceedings of N.Z.E.I.

(Continued from Page 42.)

membership of which should merit the respect of employers and others engaged in similar work. Mr. Symmons considered that the Institute will have failed if it cannot win this standing. Whilst the first of the purposes, the common meeting ground, can be achieved by an efficient Executive Committee, the high professional standing of the Institute is the responsibility of every individual member. Two things therefore are required of members—they must uphold the best principles and ethics of the profession, and they must ensure that every professional electronic engineer becomes a member of the N.Z.E.I. (Inc.). In so young an Institute, this professional standing is something which must be earned.

CHRISTCHURCH BRANCH

The Annual General Meeting of the Christchurch Branch took place on 29th June, with S/Lr. A. L. Partelow presiding.

A cheque for the sum of £5 5s. was handed to Mr. A. L. Gardner, winner of the lecturette competition, and his success was honoured by acclamation.

The chairman summarized the events of the year and gave a résumé of the business at the Institute's A.G.M. in Dunedin. It was decided that the Christchurch Branch would support the election of the Combined Branch Councillors as proposed by Dunedin.

Concluding his remarks, the chairman emphasized the vast amount of work with which the Committee had to deal last year. However, now that this had been completed, he felt sure that the Institute would make real progress.

During discussion of the financial statement it was explained that the free meeting room accounted for the low expenditure.

Election of officers for 1953-54 resulted as follows:

Chairman: Mr. A. L. Gardner.

Vice-Chairman: Mr. A. L. Partelow.

Councillors: Messrs. Gardner and Partelow.

Treasurer: Mr. J. A. Lee.

Hon. Secretary: Mr. S. P. Wills.

Committee: Messrs. H. A. L. Wiley, L. D. Hepburn, T. R. Pollard, and A. V. Butcher.

Publicity and Assistant Secretary: Mr. Butcher.

Thanking S/Lr. Partelow for his services as chairman during the past year, the new chairman, Mr. A. L. Gardner expressed his appreciation of the comprehensively planned programme of lectures covering the new year, and reminded members that they could show their support by regular attendance. He asked that each member endeavour to find one new member in the 1953-54 season.

Proceedings concluded with the showing of a film of the engineering investigation of the structural failure of "Tacoma Narrows Bridge" in the U.S.A.

Philips Experimenter

(Continued from Page 31.)

usually be accommodated on two double solder tags connected under the valve-holder retaining screws. These solder tags should not be too long and thin, otherwise their own inductance will prevent an effective connection being made to the chassis. The valve holder itself should preferably be of the type which has a metal mounting shroud around the insulating material. Rigid mounting to the chassis is then possible, and the insulating material is not held in compression as the fixing screws are tightened up. As a result of this the solder tags are not liable to become loose if any shrinkage in the insulator occurs after several years. It is bad practice to join all the earthed points together on the valve-holder and then connect them to chassis by a single wire. This tends to encourage coupling between electrodes. A far better scheme is to take separate wires down from each electrode to the nearest chassis tag, using 22 S.W.G. tinned copper wire.

Low Frequency Response

(Continued from Page 17.)

Thus, T.E = 200/50 = 4 sec. Hence, if R is 1 meg., C must be 4 μf. if the specified conditions are to be fulfilled. And if the usual coupling circuit of, say, 0.05 μf. and 1 meg. had been used, the droop would have been 40 per cent., roughly. This figure would not be quite accurate, because the formula is only an approximation, which gives quite accurate results where x/E is less than 0.1, or E/x is greater than 10, which is the same thing.

THE NEECO BALL

Yearly highlight for the electrical trade in Wellington, the 1953 Neeco Coronation Ball again drew a record crowd, and more than 360 people were present at the Majestic Cabaret on Friday, 11th September.

The Coronation decorative motif of red, white, and blue was also carried on to several hundred Neeco ash-trays in the same colours, which were quickly souvenired by arriving guests.

This year's floor show, a novelty harmonica band, gave a highly amusing interpretation of "Schooldays," which was very well received.

Among those present were Mr. C. E. Fuller, Director and General Manager, with other executive staff, the Wellington Manager, Mr. R. S. (Bob) Donovan, and visiting Managers from Auckland, Christchurch and Dunedin offices.